



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

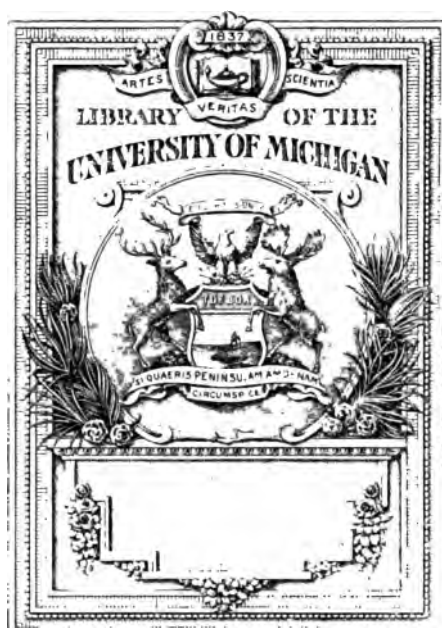
- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

2,848







QH
201
A55

9747
THE AMERICAN

MONTHLY

Microscopical Journal

VOLUME XXII

FOR

1901



WASHINGTON, D. C.

Founded in 1880 by R. Hitchcock, and published since 1887
by Chas. W. Smiley

1901

THE AMERICAN

MONTHLY

MICROSCOPICAL JOURNAL.

Entered at the post-office as second-class matter.

VOL. XXII. JANUARY, 1901. NO. 1.

CONTENTS.

BACTERIOLOGY.—William C. Dobson, M. D.,.....	1-13
NOTES ON MICROSCOPY.—Glass Cells for Microscope Slides; Number of Species of Plants ; Preservation of Medusæ ; Fresh- water Entomostracha ; Causes of Fracture of Steel Rails	13-16
The Compound Microscope in Pharmacy, Albert Schneider.....	16-18
Extracts from English Postal Microscopical Society's Notes.....	19-20
Origin of English Scientific Societies.....	21-22
BACTERIOLOGICAL NOTES.—Gonococcus Culture Medium ; Arctic Bacteria ; A Vaccine Lymph Bacillus ; Pneumococcic Arthritis Ray Fungus ; Distinguishing Colonies of Typhoid Bacillus from the Colon Bacillus ; A New Pathogenic Mould.....	22-29
MICROSCOPICAL SOCIETIES.—Quekett Club.....	30
NEW PUBLICATIONS.—Bacteriology	30

Bacteriology.

WILLIAM C. DOBSON, M. D.

BIOLOGY, chemistry, medicine and surgery, in the progress of their evolution, have contributed little by little to the growth of a new branch of learning whose subsequent development has been of incalculable importance to each. Indeed, bacteriology illustrates the old adage, "The child is father of the man," for while it is the offspring of the medicine of the past, it has established itself as the dictator of the medicine of the present and future, especially in the management of the infectious diseases.—*McFarland*.

In presenting this subject to our readers, we open with a brief history of bacteriology, as outlined by Joseph McFarland in his admirable work on Pathogenic Bacteria, published by W. B. Saunders of Philadelphia.

Our aim is not only to interest physicians, but also to stimulate microscopists to greater effort and research along these lines. Bacteriology is not only a highly important

176328

branch of medicine, but also a subject of especial interest to the microscopist. Without the aid of the microscope, little, if anything would to-day be known of pathogenic organisms, in which case the study of infectious diseases would be materially impeded, and that progress so essential to medicine and surgery, hopelessly retarded.

THE DOCTRINE OF SPONTANEOUS GENERATION.

"Among the early Greeks we find that Anaximander (43d Olympiad, 610 B. C.) of Miletus held the theory that animals were formed from moisture. Empedocles of Agrigentum (450 B. C.) attributed to spontaneous generation all the living beings which he found peopling the earth.

Aristotle (B. C. 384) is not so general in his view of the subject, but asserts that "*sometimes* animals are formed in putrefying soil, sometimes in plants, and sometimes in the fluids of other animals." Three centuries later, in his disquisition upon the Pythagorean philosophy, we find Ovid defending the same doctrine, while in the *Georgics* Virgil gives directions for the production of bees. Not only was the doctrine of spontaneous generation of life, current among the ancients, but we find it persisting through the Middle Ages, and descending to our own generation to be an accidental but important factor in the development of a new branch of science. In 1542, in his treatise called *De Subtilitate*, we find Cardan asserting that water engenders fishes, and that many animals spring from fermentation. Van Helmont gives special instructions for the artificial production of mice, and Kircher in his *Mundus Subterraneus* (chapter "De Panspermia Rerum") describes and *actually figures* certain animals which were produced under his own eyes by the transforming influence of water on fragments of stems from different plants. About 1686, Francesco Redi seems to have been the first to doubt that the maggots familiar in putrid meat arose *de novo*. "Watching meat in its passage from freshness to decay, prior to the appearance of

maggots, he invariably observed flies buzzing around the meat and frequently alighting on it. The maggots, he said, might be the half-developed progeny of these flies.

Placing fresh meat in a jar covered with paper, he found that although the meat putrefied in the ordinary way, it never bred maggots, while meat in open jars soon swarmed with these organisms. For paper he substituted fine wire gauze, through which the odor of meat could arise.

Over it the flies buzzed, and on it they laid their eggs, but the meshes being too small to permit the eggs to fall through, no maggots generated in the meat; they were on the contrary hatched on the gauze.

By a series of such experiments Redi destroyed the belief in the spontaneous generation of maggots in meat, and with it many related beliefs."

In 1683, Anthony van Leeuwenhoek, justly called the "Father of microscopy," demonstrated the continuity of arteries and veins through intervening capillaries, thus affording ocular proof of Harvey's discovery of the circulation of the blood; discovered bacteria, seeing them first in saliva, discovered the rotifers, and first saw the little globules in yeast which Latour and Schwann subsequently proved to be plants.

Leeuwenhoek involuntarily reopened the old controversy about spontaneous generation, by bringing forward a new world, peopled by creatures of such minuteness as to suggest not only a close relationship to the ultimate molecules of matter, but an easy transition from them. In succeeding years the development of the compound microscope showed these minute organisms to exist in such numbers that putrescent infusions, both animal and vegetable, literally teemed with them, one drop of such a liquid furnishing a banquet for millions. Abbe Lazzaro Spallanzani (1777) filled flasks with organic infusions, sealed their necks, and, after subjecting their contents to the temperature of boiling water, placed them under cou-

ditions favorable for the development of life, without however, being able to produce it. Spallanzani's critics, however, objected to his experiment on the ground that air is essential to life, and that in his flasks the air was excluded by the hermetically-sealed necks. Schulze (1836) set the objection aside by filling a flask only half full of distilled water, to which animal and vegetable matters were added, boiling the contents to destroy the vitality of any organisms which might already exist in them, then sucking daily into the flask a certain amount of air which had passed through a series of bulbs containing concentrated sulphuric acid, in which it was supposed that whatever germs of life the air might contain would be destroyed. This flask was kept from May to August; air was passed through it daily, yet without the development of any infusorial life. It must have been a remarkably germ-free atmosphere in which Schultze worked, for, as was shown by those who repeated his experiment, under the conditions that he regarded as certainly excluding all life, germs can readily enter with the air. The term "infusorial life" having been used here, it is well to observe that during all the early part of their recognized existence the bacteria were regarded as animal organisms and classed among the infusoria. Tyndall, stimulated by the work of Pasteur, conclusively proved that the micro-organismal germs were in the dust suspended in the atmosphere, not ubiquitous in their distribution.

His experiments were very ingenious and are of much interest. First preparing light wooden chambers, with one large glass window in the front and one smaller window in each side, he arranged a series of test-tubes in the bottom, half in and half out of the chamber, and a pipette in the top, working through a rubber diaphragm, so that when desired, the tubes, one by one could be filled through it. The chamber was first allowed to stand until all the contained dust had settled, and was then submitted to an

optical test to determine the purity of its atmosphere, a powerful ray of light being passed through the side windows. When viewed through the front window, this ray was visible as long as there were particles suspended in the atmosphere to reflect it. When the dust had completely settled and the light ray was invisible because of the purity of the atmosphere, the tubes were cautiously filled with urine, beef broth, and a variety of animal and vegetable broths, great care being taken that in the manipulation the pipette should not disturb the dust. Their contents were then boiled by submergence in a pan of hot brine placed beneath the chamber, in contact with the projecting ends of the tubes, and allowed to remain undisturbed for days, weeks or months. In nearly every case life failed to develop after the purity of the atmosphere was established.

The following extracts from Tyndall's work will illustrate how slowly the doctrine of spontaneous generation was abandoned: "At a meeting of the Pathological Society of London, held April 6, 1875, the 'germ theory' of disease was formally introduced as a subject for discussion, the debate being continued with great ability and earnestness at subsequent meetings.

The conference was attended by many distinguished medical men, some of whom were profoundly influenced by the arguments, and none of whom disputed the facts brought forward against the theory on that occasion." "The leader of the debate, and the most prominent speaker, was Dr. Bastian, to whom also fell the task of replying on all the questions raised." "The coexistence of bacteria and contagious disease was admitted; but, instead of considering these organisms as probably the essence, or an inseparable part of the essence, of the contagium, Dr. Bastian contended that *they were pathological products spontaneously generated in the body after it had been rendered diseased by the real contagium.*"

"The grouping of the ultimate particles of matter to form living organisms Dr. Bastian considered to be an operation as little requiring the action of antecedent life as their grouping to form any of the less complex chemical compounds." "Such opposition, must of course, stand or fall by the evidence which its supporter is able to produce, and accordingly Dr. Bastian appeals to the law and testimony of experiment as demonstrating the soundness of his view." "He seems quite aware of the gravity of the matter at hand; this is his deliberate and almost solemn appeal: "With the view of settling these questions, therefore, we may carefully prepare an infusion from some animal tissue, be it muscle, kidney or liver; we may place it in a flask whose neck is drawn out and narrowed in the blowpipe flame; we may boil the fluid, seal the vessel during ebullition, and, keeping it in a warm place, may await the result, as I have often done. After a variable time the previously heated fluid within the hermetically-sealed flask swarms more or less plentifully with bacteria and the allied organisms, even though the fluids have been much degraded in quality by exposure to the temperature of 212° F., and have in all probability been rendered far less prone to engender independent living units than the unheated fluids in the tissue would be. These somewhat lengthy quotations are of great interest, for they show exactly the state of the scientific mind at a period as recent as twenty-five years ago.

FERMENTATION AND PUTREFACTION.

As in the biologic world the generation of life was an all-absorbing problem, so in the world of chemistry the phenomena of fermentation and putrefaction were inexplicable so long as the nature of the ferments was not understood. Cagniard Latour and Schwann in the year 1837 succeeded in proving that the minute oval bodies which had been observed in yeast since the time of Leeuwen-

hoek were living organisms—vegetable forms—capable of growth.

While yeast was looked upon as an inert substance in the act of fermenting, it was impossible to understand how it could impart fermentation to other substances; but when it was learned by Latour that the essential element of yeast was a growing plant, the phenomenon became a perfectly natural consequence of life.

Not only the alcoholic, but also the acetic, lactic and butyric fermentations have been shown to result from the energy of low forms of vegetable life, chiefly bacterial in nature. Prejudice, however, prevented many chemists from accepting this view of the subject and Liebig strenuously adhered to his theory that fermentation was the result of internal molecular movement which a body in the course of decomposition communicates to other matter in which the elements are connected by a very feeble affinity. Pasteur was the first to declare and prove that fermentation is an ordinary chemie transformation of certain substances, taking place as the result of the action of living cells, and that the capacity to produce it resides in all animal and vegetable cells, though in varying degree. In 1862, he published a paper "On the Organized Corpuscles existing in the Atmosphere," in which he showed that many of the floating particles which he had been able to collect from the atmosphere of his laboratory were organized bodies. If these were planted in sterile infusions, abundant crops of micro-organisms were obtainable. By the use of more refined methods he repeated the experiments of others, and showed clearly that "the cause which communicated life to his infusions came from the air, but was not evenly distributed through it." Three years later he showed that the organized corpuscles which he had found in the air were the spores or seeds of minute plants, and that many of them possessed the property of withstanding the temperature of boiling wa-

ter—a property which explained the peculiar results of many previous experimenters, who failed to prevent the development of life in boiled liquids enclosed in hermetically-sealed flasks. Chevreul and Pasteur (about 1836) proved that animal solids did not putrefy or decompose if kept free from the access of germs, and thus suggested to surgeons that the putrefaction which occurred in wounds was due rather to the entrance of something from without, than to some change within.

The deadly nature of the discharges from these wounds had been shown in a rough manner by Gaspard as early as 1822, by injecting some of the material into the veins of animals.

THE STUDY OF THE INFECTIOUS DISEASES.

Probably the first writing in which the direct relationship between micro-organisms and disease is indicated is that by Varro, which says: "It is also to be noticed, if there be any marshy places, that certain minute animals breed there which are invisible to the eye, and yet, getting into the system through mouth and nostrils, come serious disorders (diseases which are difficult to treat)"—a doctrine which, as Prof. Lamberton, to whom I am indebted for the extract, points out, is handed down to us from "the days of Cicero and Cæsar," yet corresponds closely to the ideas of mælarial which we entertain at present.

Surgical methods of treatment depending for their success upon exclusion of the air, and of course, incidentally if unknowingly, exclusion of bacteria, seem to have been practiced quite early. Theodoric of Bologne about 1260 taught that the action of the air upon wounds induced a pathologic condition predisposing to suppuration. He also treated wounds with hot wine fomentations. The wine was feebly antiseptic, kept the surface free from bacteria, and the treatment was, in consequence, a modification of what in later centuries formed antiseptic surgery.

Henri de Mondeville in 1306 went even further than Theodoric, whom he followed, and taught the necessity of bringing the edges of a wound together, covered it with an exclusive plaster compounded of turpentine, resin and wax, and then applied the hot wine fomentation. In 1671 Kircher wrote a book in which he expressed the opinion that puerperal purpura, measles and various other fevers were the result of a putrefaction caused by worms or animalculæ. His opinions were thought by his contemporaries to be founded upon too little evidence, and were not received.

Plencig of Vienna became convinced that there was an undoubted connection between microscopic animalcules exhibited by the microscope and the origin of disease, and advanced this opinion as early as 1782.

Unfortunately, the opinions of Plencig seem not to have been accepted by others, and were soon forgotten. In 1704 John Colboch described "a new and secret method of treating wounds by which healing took place quickly, without inflammation or suppuration." Boehm succeeded in 1838 in demonstrating the occurrence of yeast plants in the stools of cholera, and conjectured that the process of fermentation was concerned in the causation of that disease.

In 1840, Henle determined that the cause of infectious diseases was to be sought for in minute living organisms or fungi. He may be looked upon as the real propounder of the *Germ Theory of Disease*, for he not only collected facts and expressed opinions, but also investigated the subject ably. The requirements which he formulated in order that the theory might be proved were so severe that he was never able to attain to them with the crude methods at his disposal. They were so ably elaborated, however, that in after years they were again postulated by Koch, and it is only by strict conformity with them that the definite relationship between bacteria and disease has

been determined. Briefly summarized the requirements are as follows :

1. A specific micro-organism must be constantly associated with the disease.
2. It must be isolated and studied apart from the disease.
3. When introduced into healthy animals it must produce the disease.

Pollender (1849) and Davaine (1850) succeeded in demonstrating the presence of the anthrax bacillus in the blood of animals suffering from and dead of that disease. Several years later (1863), Davaine, having made numerous inoculation-experiments, demonstrated that this bacillus was the *materies morbi* of the disease. The bacillus of anthrax was probably the first bacterium shown to be specific for a disease. Being a very large bacillus and a strong vegetative organism, its growth was easily observed, while the disease was one readily communicated to animals for experimental purposes. In 1873 Obermeier observed that actively motile flexible spiral organisms were present in large numbers in the blood of patients in the febrile stages of relapsing fever. Klebs who was one of the pioneers of the germ theory, published in 1872, his work upon septicemia and pyemia, in which he expressed himself convinced that the causes of these diseases must come from without the body, Billroth strongly opposed such an idea, asserting that fungi had no especial importance either in the processes of disease or in those of decomposition, but that, existing everywhere in the air, they rapidly developed in the body as soon as through putrefaction a "Faulnisszymoid," or through inflammation a "phlogistischeszymoid," supplying the necessary feeding grounds, was produced. In 1875 the number of scientific men who had entirely abandoned the doctrine of spontaneous generation and embraced the germ theory of disease was small and most of those who accepted it were

experimenters. A great majority of medical men either believed, like Billroth, that the presence of fungi where decomposition was in progress was an accidental result of their universal distribution, or, being still more conservative, retained the old unquestioning faith that the bacteria, whose presence in putrescent wounds as well as in the artificially prepared media was unquestionable, were spontaneously generated there. Before many of the important bacteria had been discovered, and while ideas upon the relation of micro-organisms to disease were most crude, there were suggested some practical applications that produced greater agitation and incited more observation and experimentation than anything suggested in surgery since the introduction of anaesthetics—namely, *antisepsis*. "It is to one of old Scotia's sons, Sir Joseph Lister, that the everlasting gratitude of the world is due for the knowledge we possess in regard to the relation existing between micro-organisms and inflammation and suppuration, and the power to render wounds aseptic through the action of germicidal substances." Lister, convinced that inflammation and suppuration were due to the entrance of germs from the air, instruments, fingers, etc., into wounds, suggested the employment of carbolic acid for the purpose of keeping sterile the hands of the operator, the skin of the patient, the surface of the wound, and the instruments used. He finally concluded an operation by a protective dressing to exclude the entrance of germs at a subsequent period. Listerism originated in 1875, and when Koch published his famous work on the *Wundinfektionskrankheiten*, (or traumatic infectious diseases), in 1878, it spread slowly at first, but surely in the end, to all departments of surgery and obstetrics.

From time to time, as the need for them was realized, the genius of the investigators provided devices which materially aided them in this work. Some of these have been indispensable throughout all subsequent investiga-

tions and have made possible many discoveries that must otherwise have failed. Among them may be mentioned the improvement of the compound microscope, the use of sterilized culture-fluids by Pasteur, the introduction of solid culture-media and the isolation methods by Koch, the use of the cotton plug by Schroeder and van Dusch, and the introduction of the anilin dyes by Weigert. It is interesting to note that after the discovery of the anthrax bacillus by Pollender and Davaine in 1849 there was a prolonged period during which no important pathogenic organisms were discovered, but during which the technic was being elaborated. This was again followed by a period during which important additions followed each other in rapid succession.

Thus, in 1873, Obermeier discovered the *Spirillum Obermeieri* of relapsing fever.

In 1879, Hansen announced the discovery of bacilli in the cells of leprous nodules. The same year Neisser discovered the gonococcus to be specific for gonorrhoea.

In 1880, the bacillus of typhoid fever was first observed by Eberth, and independently by Koch.

In 1880, Pasteur published his work upon "Chicken-cholera." In the same year Sternberg described the pneumococcus, calling it the *Micrococcus Pasteur*.

In 1882, Koch made himself immortal by his discovery of and work upon the tubercle bacillus. The same year Pasteur published a work upon *Rouget du Porc*, and Löffler and Schultz reported the discovery of the bacillus of glanders.

In 1884, Koch reported the discovery of the "comma bacillus," the cause of cholera, and in the same year Löffler discovered the diphtheria bacillus, and Nicolaier the tetanus bacillus.

In 1892, Canon and Pfeiffer discovered the bacillus of influenza.

In 1894, Yersin and Kitasato independently isolated the

bacillus causing the bubonic plague then prevalent in Hong-Kong.

In 1894, Sanarelli discovered the bacillus *icteroides*, thought to be specific for yellow fever.

A new era in bacteriology, and probably the most triumphant result of the modern scientific study of disease, was inaugurated by Behring, who presented to the world the "Blood-serum therapy," and showed as the result of prolonged, elaborate and profound study of the subject of immunity, that in the blood of animals with acquired immunity to certain diseases (diphtheria and tetanus) a substance was held in solution which was potent to save the lives of other animals suffering from the same diseases."

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

TO MAKE GLASS CELLS FOR MICROSCOPE SLIDES.—There are several methods for making glass cells for slides of insects, samples of ore, etc., each more or less convenient, according to the depth of the proposed cell. For cells from one-tenth inch in depth and upward, we have found the plan of cutting a ring off a bit of soft glass tubing, the easiest and best. This is done very quickly and surely by running a diamond pencil around the tubing at the required distance from the end, and touching the line thus made with the point of a red-hot poker or iron rod. To run the line smoothly and evenly, make a little supporter for the tube by nailing a couple of upright strips, notched at the top in V shape, to a wooden block, six inches long. Let the tube rest in the notches, apply the diamond firmly to the glass, and revolve the tube slowly, away from the person. A little practice will enable one to make a clean-cut scratch entirely around the tubing. In the absence of the diamond, a little slitting file may be used.

After the ring is removed, smooth the edges by grinding with emery powder on a leaden plate. For shallow cells, an

ordinary cover-glass may be used, by cementing it to a metallic ring of proper size, and when firmly fixed, punch a hole through the center. Smooth the edge of the hole with a round file. Small irregularities will not be visible when the cell is filled with mounting medium. Another plan is to wet the cover-glass with a little saliva, and press it down on the center of the turn-table. Set the plate to revolving, and touch the surface of the glass with a writing diamond. With a little practice, this is by far the neatest and most expeditious way.—*National Druggist*.

NUMBER OF SPECIES OF PLANTS.—Professor S. H. Vines, in his opening address to the Botanical Section of the British Association at Bradford, gave some interesting figures as to the number of species of plants at present known. The figures may be tabulated as follows:

SPECIES OF PLANTS.		
Phanerogams	{ Dicotyledons	78,200
	{ Monocotyledons	19,600
	{ Gymnosperms	2,420
	{ Subsequent additions	100,220 5,011
		105,231
Pteridophyta	{ Filicinae (including Isoetes)	
	{ about.	3,000
	{ Lycopodiinae, about	432
		20
		3,452
Bryophyta	{ Musci	4,609
	{ Hepaticae	3,041
		7,650
Thallophyta	{ Fungi, (including Bacteria)	39,663
	{ Lichens	5,600
	{ Algæ (including 6000 Diatoms)	14,000
		59,263

Making a grand total of. 175,596
which, when compared with the 10,000 species of plants known

to Linnaeus in the latter half of the last century, show how vast have been our additions to the knowledge of plants. The amount of work for microscopists especially in the latter sections, appears to be unlimited.

PRESERVATION OF MEDUSÆ.—Medusæ should be killed by adding a few drops of concentrated chromic acid to sea-water containing them. Then well wash in sea-water until the chromic acid has disappeared.

Gradually add glycerin and alcohol to water, until objects are in pure glycerin and alcohol of same specific gravity as sea-water.

FRESHWATER ENTOMOSTRACHA.—Mr. D. J. Scourfield, in the Proceedings of the South London Entomological and Natural History Society, calls attention to the value of Entomotracha in experimental biology. "Their commonness in all parts of the country, their transparency, the ease with which they can be isolated and reared under all sorts of conditions, mark out the Entomotracha as particularly well fitted for observation in connection with even the most fundamental biological problems of the day." He adds: "We badly want detailed studies on local faunas, on the seasonal distribution and variation of different species, on the faunas of various types of ponds, on the food of the most abundant forms, and many similar subjects."

CAUSES OF FRACTURE OF STEEL RAILS.—The value of the microscopical examination of steel will be brought prominently before the general public by the recently issued report of the Board of Trade committee appointed to examine into the cause of fracture of a steel rail at St. Neot's station on Dec. 10, 1895, by which a serious accident happened to the down Scotch express. The report itself, dealing as it does with various experimental work undertaken by well-known experts, is somewhat inconclusive, but the microscopic examination by Sir William Roberts-Austen gave results of the utmost interest and value. Briefly stated, it may

be said that, according to this eminent authority, good rail steel consists of "ferrite," or iron free from carbon, and "pearlite," which is a mixture of alternate bands of ferrite and "cementite," the carbide corresponding to the formula Fe_3C .

The well developed pearlite with a conspicuous banded structure is readily shown microscopically, and is characteristic of good rail steel. When, however, steel is hardened by "quenching," pearlite is absent, and "martensite," which consists of interlacing crystalline fibres without banded structure, takes its place. Sir William Roberts-Austen says that "the presence of martensite in a rail should at once cause it to be viewed with extreme suspicion, as showing that the rail is too hard locally to be safe in use." The broken rail at St. Neot's showed an outside layer of martensite one hundredth of an inch thick. The report deals further with minute cracks found in this and other rails, and the enormous increase in liability to fracture occasioned thereby, and one conclusion drawn is that patches of martensite can be produced in a rail, when in use, by local treating caused by skidding, followed by the rapid extraction of heat by the cold rail. It is thus evident that the microscope will prove to be an increasingly valuable means of studying the complex structure of steel. For this purpose and for the examination of alloys it is used, and already a quite voluminous literature is growing up around the subject.

The Compound Microscope in Pharmacy.

ALBERT SCHNEIDER, M. D., Ph., D.

Compound Microscopes with objectives and oculars fairly well corrected for spherical and chromatic aberration, have been in use for nearly seventy-years, but it is only recently that they have been extensively employed in pharmaceutical practice. This is due to the fact that pharmacy as a science is of recent origin; only within the last decade have the courses of instruction in the colleges of pharmacy been based upon scientific principles—at least

this applies to the department of botany and its various branches, as vegetable materia-medica, vegetable pharmacography and powdered vegetable drugs. The leaders in pharmaceutical education admit that a good compound microscope is a part of the necessary equipment of the intelligent, competent, practicing pharmacist. It is, therefore, much to be regretted that there are a number of so-called colleges of pharmacy from which students are graduated, who have never used or even seen a compound microscope.

Such graduates are wholly unfit for the duties of a modern pharmacist, because it is only through the intelligent use of this instrument that he is enabled to vouch for the purity of most of the vegetable drugs and many other substances used in his practice. The advanced workers in Pharmaceutical Vegetable Histology abroad, as well as in this country, have employed the microscope for a number of years. A few eminent specialists of Germany and France have studied the histology of medicinal plants since 1825. The earlier German investigators also devoted much of their attention to the microscopical examination of foods and spices, textile fabrics and various other commercial products. Some of this work was really herculean, and it would be highly interesting to enter into a fuller discussion, but space will not permit. According to Pocklington, the use of the compound microscope in English pharmacy, dates from 1850, when Dr. Hassell laid before the Botanical Society of London, a paper on the histology of coffee and its adulterants. The microscope was introduced into American pharmacy a few years later. In England, as well as in the United States, the use of the compound microscope in pharmaceutical practice progressed very slowly, until about 1880 or a few years later, in spite of the earnest recommendation of a few leading teachers and investigators. Since 1880, some very energetic work has been done in America. Many of the

investigations are, however, defective, and a mere repetition of the work already done in Continental Europe, particularly in Germany.

It is much to be regretted that the truly scientific spirit does not permeate the English-speaking nations. The great majority of the scientific work done is primarily instigated and abetted by commercialism and hence does not attain to the lasting, far reaching results of the work of our patient and careful German investigators whose prime motive is to find out. In 1853, Dr. F. Hoffmann recommended the use of the compound microscope in American pharmacy, calling attention to the value of this instrument in the examination of vegetable drugs and their adulterants.

It was, however, not until some thirty years later that the compound microscope was used to any considerable extent in the study of vegetable drugs. It was looked upon as an impracticable instrument, having no commercial significance, and presenting no advantages over the simple microscope. Now and then some teacher or investigator would arise and reiterate the recommendations of Dr. Hoffman, or present some new phase of microscopic work in pharmacy, only to be met with the same indifference, if not actual opposition and ridicule. It is, therefore, little wonder that slow progress should have been made in the histologic study of medicinal plants. In Germany the compound microscope found a steady use in pharmaceutical practice. In 1865, Berg published his excellent atlas illustrating the histology of the more important vegetable drugs, and even at this date there is nothing produced by an English or American investigator which equals this work.—*Meyer Brothers Druggist*.

Formaldehyde.—It is put into milk for a preservative. Five tests for its detection are reported by Herman Harms in the Bulletin of Pharmacy, Detroit, Mich. Send 10 cents for the August number of 1900.

Extracts From English Postal Microscopical
Society Note Books.

WILLIAM H. BURBIDGE.

Polyp of Alcyonium palmatum. One of the Anthozoa, is of a higher organization than Hydroida. It is the cream colored, fleshy substance commonly called dead men's fingers. The protruded polyp is an elevated tubular column of translucent substance terminating in an expanded flower of eight slender-pointed petals—the tentacles of the polyp. "The spicules in this creature are of interest, being of varying forms. In *Alcyonium* the sexes are separate, and even the sexes of different colonies are distinct. In any one commonwealth the individuals are either all males or else all females.

The ova and sperm masses are borne on stalked capsules upon the free edges of the mesenteries, or straight bands that run down the tube below the curled up filaments, and development takes place outside the parent.

The embryos are free, swimming by cilia. They soon fix themselves and by continued budding produce colonies." (Hornell.)

STALKED LARVA OF ANTEDON.—This is better known by the name of *Comatula Rosacea*, or "feather-star." Mr. Hornell, in his "Journal of Marine Zoology," describes the delight with which he first pulled up, on a lobster-pot, a colony of this most lovely of star-fishes. I can also recall a red-letter day long ago when I pulled up in a dredge a mass of these beauties in Tar bay, one of the greatest prizes, I think, round our English coast. Its body consists of a disc some half inch across, from which proceed ten long slender arms, bearing numerous pinnules on either side. These often reach $3\frac{1}{2}$ inches, so that the creature has a span of 7 inches.

The sexes are separate, and the genital organs are situated not in the body disc, but in the tiny pinnules of the

arms. The fertilized ova are set free as barrel-shaped embryos which acquire four encircling bands of cilia. Next appear a few minute calcareous plates within this embryo, forming as it were, a tiny cask set upon a tiny stalk.

Free swimming life being now almost ended, a disc containing a perforated plate appears on the lower extremity of the stalk; and by this attachment is made to any object that happens to be in the way. The soft, barrel-shaped mass of the swimming larva has now shrunk and adapted itself to the form of the enclosed calcareous skeleton, and the creature is fairly launched upon the stalked and anchored period of its life. In this stage the skeleton is made up of a basal plate, rooting the animal to its host, a considerable number of joints set end to end forming a stalk upon which is seated the cup-shaped frame-work of the body, consisting of two circles of large perforated plates, respectively the "basals" and "orals."

The former form the base of the cup, and the latter the upper ones. Growth after this is rapid; other circles of plates appear, the ten arms proceed from one of the circles, the top joint enlarges into a plate-like structure and develops claw-like jointed organs, the cirri. The body breaks off from its stalk and becomes free to creep among the rocks at will, or swim gracefully with rhythmic beats of its long feather-like arms. Special interest attaches to this beautiful creature from the great part played by its relations, if not its ancestors, which lived during former periods of the earth's history, for the *Encrinites*, whose remains contributed to greatly build up the huge masses of our mountain limestones, were but gigantic *Pentacrinoids* of structure practically identical with the stalked larva of the *Antedon* (*Hornell*). Dr. Carpenter's "Microscope" has a good plate of the rosy feather-star. My remarks have been largely taken from "Gosse" and from Cassells "Natural History," also from Hornell's "Journal of Marine Zoology."

Origin of English Scientific Societies.

From SCIENCE-GOSSIP.

At the opening meeting of the 147th Session of the Society of Arts, held on November 21st, 1900, the address given was by Sir John Evans, K. C. B., D. C. L., LL.D., Sc. D., F. R. S., upon the "Origin, Development, and Aims of our Scientific Societies."

Sir John Evans stated that no learned Society had received a Royal Charter before 1662, when the Royal Society was incorporated. The Society of Antiquaries was however, much older, having been founded about 1572. Among the meeting places of this staid and respectable body was the "Young Devil" tavern in Fleet Street. The Society before which the address was given was founded in 1754, and incorporated nearly a century later, in 1847, as the "Society for the Encouragement of Arts, Manufactures and Commerce." From the trio of Societies—the Royal, Antiquaries and Arts—Sir John mentioned that, nearly all the numerous leading learned societies in existence in this country had sprung by a natural process of evolution. The first, perhaps, was the Medical Society, founded in 1773. The Linnean Society for the cultivation of Natural History followed in 1788. The lecturer pointed out that during the century now drawing to its close the vast advances in science and the innumerable aspects which it assumed had led to the foundation of the numerous scientific societies with more or less limited scope. These were by no means confined to science as represented by the ordinary acceptance of the word, as many were literary and philosophical in their aims; that of Manchester dating back to 1781. The offshoots of the Society of Antiquaries had not been so numerous, nor so important, as those from the Royal Society; the field of archæological research being more restricted than that of pure "natural knowledge." The Society of Arts was the

first in England to devote attention to the important subjects of forestry and agriculture ; the Royal Agricultural Society not originating until 1838. It was the Society of Arts also that laid the foundation for the Institute of Civil Engineers and its offshoots. At the Society of Arts in 1841 there was formed the Chemical Society, from which arose the Institute of Chemistry in 1877. The same birth-place may be claimed for the Society of Chemical Industry and the Sanitary Institute. Similarly originated were the City Guilds Institute and even the Science and Art Department at South Kensington, though the latter was influenced by the Great Exhibition of 1851. The Photographic Society grew from an exhibition of photographs, the first of its kind, held in the Society's rooms.

It was also the parent of the Royal College of Music. Sir John Evans pointed to the fact that without our Societies it would have been impossible for knowledge to have progressed as it has during the past century. They bring about that healthy competition which stirs men from rest or torpor ; a state once described by the secretary of the Society of Antiquaries, when he said ; "Would to God there was nothing in the world older than a new-laid egg."

Bacteriological Notes.

BY THE EDITOR.

IMPROVED CULTURE MEDIUM FOR GONOCOCCUS.—Tubes of gelose are melted, and cooled to 40° C.. Half the volume of blood—drawn directly from the artery of a rabbit—is added to the tubes of gelose, which are cooled in a slanting position. The growth of the gonococcus in this medium is very rapid, characteristic colonies being present in twenty-four hours.—*Annales Dermatologie*.

BACTERIA IN THE ARCTIC REGIONS.—Some interesting facts concerning the freedom of the air, water, and even the intestinal contents of animals of Arctic regions, from

bacteria are communicated by Dr. Levin, of Stockholm, (*Annales de l'Institut Pasteur*) who took part in the Natthorst expedition during the summer of 1898. Working each time with 20,000 liters of air, he found practically no bacteria. Sea-water, snow and ice yielded on an average one bacterium per 11 c.c. In twelve samples of brown mud he found only a single bacterium. The intestinal contents of polar bears, eider ducks and other birds, sharks, sea urchins, anemones, and crabs were nearly always sterile. Not only did he obtain no growths, but he was unable to find evidence of the presence of bacteria after staining the intestinal contents with the usual agents. The results confirm the conclusions of Nencki, Nuttall and Theirfelder concerning the presence of bacteria as a non-essential factor in digestion.—*American Journal of the Medical Sciences*.

A NEW BACILLUS FROM VACCINE LYMPH.—Nakanishi (*Centralbl. f. Bakt.* Bd. xxvii, No. 18) describes a bacillus which he finds constantly present in vaccinia pustules, and which he has experimentally investigated. This is present in the epithelial cells of the "vaccine pulp" of calves, either as a rod-shaped form, staining in a bipolar fashion, or as a spherical or oval form taking the stain less perfectly. In the lymph from children, on the other hand, the rod-form is not found, but large, round refractive organisms are present, similar to those found in calf lymph, which are looked upon by the writer as variation forms of the bacillus. Pure cultures of the bacillus were obtained on agar plates both from the calf lymph and from lymph drawn from seven-days-old vesicles on the arms of children. The organism grows but on solidified blood-serum, and resembles morphologically, the diphtheria and the so called pseudo-diphtheria bacilli; it is a facultative anaerobe.

PNEUMOCOCCIC ARTHRITIS.—A case of pneumococcic ar-

thrititis with fatal termination has recently been reported. The illness began as an ordinary pneumonia and was later complicated by an arthritis of the left shoulder. After death, possibly within one hour, the skin over the deltoid muscle was seared with a hot iron and a sterilized needle was thrust into the joint. A syringe of thick greenish, creamy pus was drawn off. This contained an abundance of pneumococci in pairs and short chains of three or four elements, distinctly encapsulated and in pure culture. The leucocytes were polynuclear. The cocci stained well by Gram's method, and when stained by Ziehl's solution and partly decolorized in one per cent acetic acid, the capsules were very well shown. Typical dew-drop cultures were obtained on agar and blood serum. Its virulence to mice or rabbits was not tested.

RAY FUNGUS.—R. J. Godlee, detailing a series of cases of Actinomycosis, in London *Lancet*, says: To the clinician the first sight of the fungus is usually obtained in the pus evacuated from an abscess, or in the expectoration, and it is visible to the naked eye as small, round granules, sometimes very minute, sometimes larger, oftenest of a pale yellow color, but sometimes white, which are easily demonstrated by allowing the pus, or expectoration to flow down the side of the test-tube while it is held up to the light, or to run over a microscopic slide.

They have been compared to particles of iodoform, but they are obviously rounded and not of such a bright yellow color. One should always be on the *qui vive* and get into the habit of looking at the pus from any abscess of doubtful origin from this point of view, but especially if, on opening the abscess, the amount of pus was less than was expected and the finger passes into an indefinite soft mass which bleeds with great freedom. The sensation imparted to the finger is very characteristic when one is accustomed to it. The hemorrhage suggests what is the fact, that the growth does not interfere with vessels and

is in itself very vascular. If a yellow granule be placed unstained in a little water on a slide and the cover-glass be gently pressed upon it, it will be seen under a low power to be made up of rounded masses which are yellowish on the circumference, but less colored in the centre. Under a high power the centre is seen to consist of a densely felted mass of threads which is called the mycelium, and the circumference to contain the so-called clubs which, from their radiated arrangement, have given the name to the fungus.

In some cases, however, these are not to be seen. It must not be supposed that the mycelium is made up of well-defined threads like the mycelium of a mould or a mushroom. It consists of extremely delicate branched threads in which a double outline is scarcely to be distinguished, and which sometimes appear to be made up only of chains of cocci, which has suggested the latest name for the organism, "*streptothrix actinomyces*." We are told that the organism is easily grown on various media and that it then consists at first of these threads, which after sometime end in chains of streptothrix, which are supposed to constitute the spores of the fungus. At all events these, if transferred to another medium, bud out into the threads of the so-called mycelium. The clubs are very seldom if ever produced in artificial cultures. In old cultures bulbous ends to the threads are sometimes observed, and it is held that the clubs are only produced when the organism is growing under difficulties.

Although it is practically certain that the organism grows on cereals and grass, very little is known of life-history as a vegetable parasite. It is, however, quite certain that it gains access to the bodies of men and beasts on pieces of corn or grass which either stick in the teeth, or mouth, or are swallowed or inhaled—the moral of which ought to be, that we should give up the tempting habit of chewing fresh corn, sucking straws or putting pieces

of fresh grass into our mouths. We cannot help inhaling the dust of a threshing-machine and are most likely exposed to the inroads of this pestilent organism in a thousand ways which it is impossible to guard against. Once settled in the mucous membrane of the mouth, oesophagus, alimentary tract, or respiratory passages, it begins to grow and creates inflammation. Sometimes an ulcer is produced, sometimes a sort of tumor, and it is usually the latter condition that the surgeon is called upon to treat or the pathologist to examine. The tumor is of a pale yellowish color, globular in shape, riddled with holes of a larger or smaller size containing pus, and very vascular, although it presents a superficial resemblance to the interior of a tuberculous or gummatous deposit. It infiltrates all the tissues with which it comes in contact, spreading in the intermuscular planes and to some extent into the muscles, extending far and wide into the calcareous structure of bones, occupying extensive portions of the solid viscera and forming communications between the hollow viscera.

It sometimes attacks the skin, sometimes it is met with in the lymphatic glands and occasionally it is distributed to distant parts of the body by the vascular system, exactly as in embolic pyemia ; it is then found in the brain or joints, or indeed any part of the body.

The younger forms are wedge or "candle-flame" shaped; others are rod-shaped, and in old cultures, club-shaped and rounded forms are common. Experimental inoculations in calves and guinea-pigs were negative. In rabbits, intra-peritoneal inoculations were also negative in result, but ulceration is produced by inoculation of the cornea, and in the epithelial cells of this, round or oval bodies are found. These are identical with the bodies described by Guinieri and Pfeiffer in the corneal tissue inoculated with vaccine lymph, and in the corneal vesicles in variola, and which were considered by them to be probably pro-

tozoa. By inoculation of cultures of the bacillus into the arms of several children, a student, and himself, the writer was successful in producing typical vesicles. Two other students gave no reaction; possibly they were immune. He argues that the described bacillus is in all probability the specific agent in vaccinia, but with regard to the round and oval forms found in the corneal epithelium, he hesitates to decide whether they are really varieties of the bacillus so modified by the unfavorable site on which they are growing or whether they are degeneration foci in the epithelial cells themselves. The fact that somewhat similar shapes are found in old cultures seem to give countenance to the first view. Much evidence has been collected to show that the protozoa of Guianieri, the so-called cytorrhyctes variolæ, are characteristic and specific and as the writer has produced identical forms by inoculation of cultures of this bacillus, he deduces that the bacillus is characteristic of small-pox lymph, and in all probability is the exciting factor in small-pox itself. Further, as the organism resembles the diphtheria bacillus, he draws a parallel between this disease and variola clinically and pathologically, and finds close analogies.—*British Medical Journal*.

METHOD OF DISTINGUISHING COLONIES OF TYPHOID BACILLI FROM THE COLON BACILLUS.—Dr. J. A. Case (*Philadelphia Medical Journal*; *Indiana Lancet*) describes a specially prepared culture medium recommended by Piorkoski. This is made by taking 100 parts of urine that has undergone ammoniacal fermentation, to which is added 0.5 parts of peptone and 3.3 parts gelatin. The whole is heated over a water-bath for one hour, then filtered, placed in test-tubes and sterilized in the usual manner. The sterilization is repeated for ten minutes on the following day. To make the test, the stool of a patient is first rubbed up in a mortar, and three tubes taken, which

are inoculated as follows: The first tube by the contents of two platinum loops; the second tube is inoculated from the first, using four loops, and the third by six or eight loops from the second dilution. The contents of each tube is then poured into Petri dishes and placed in a cool place until the gelatin is solidified; it is then placed in an oven and kept at a temperature of 22° C. for twenty-four hours. At the end of this time the typhoid colonies are seen as transparent, filamentous bodies, along side of the coli colonies, which are rounded, with well defined edges. According to the writer, Piorkoski claims to have found the typhoid colonies as early as three days after the beginning of the illness, and he furthermore claims that they may be demonstrated in every case. Twenty-six cases have been tested, in all of which the results of the test were confirmed by the subsequent clinical history.—*Modern Medicine*.

A NEW PATHOGENIC MOULD.—W. H. Ophuls and H. C. Moffitt in the Philadelphia *Medical Journal* present a preliminary report of a new pathogenic mould which was formerly described as a protozoon under the name *cccidiodes immitis pyogenes*.

The patient from whom the organism was obtained was a farm laborer aged nineteen, whose sickness began with a chill, eleven weeks before admission to the hospital.

After a few days the left pleura was tapped and a large quantity of clear fluid was removed. The patient had an irregular fever, the temperature at times reaching 104 ° F. The Diazo reaction was present, but not the Widal. About four weeks after the onset of his trouble, painful inflammation of the knees, elbows, wrists and ankles developed. Later, there was a fluctuating swelling over the left eye, and a large gland developed in the supra-clavicular fossa. There was cough, with muco-purulent and occasionally bloodstained sputum. There were no tubercle bacilli in the sputum. The lungs were irregu-

larly consolidated. There was bronchial breathing and harsh and dry rales. The heart was enlarged, but otherwise normal.

The leucocyte count was seventeen thousand. The patient died, ten days after admission, about twelve weeks after the onset of the disease. The autopsy showed acute bronchial pneumonia, abscesses of the retro-peritoneal lymph glands, and encapsulated empyema, enlarged and softened spleen, with colloid swelling of the liver and kidneys. In all the diseased parts that were examined there were found peculiar parasitic organisms, which in the few recorded cases, have been described as protozoa. The life history of these parasites shows the youngest forms as small, spherical masses of protoplasm enveloped in a membrane. The protoplasm is granular, stains well and is occasionally vacuolated. The organism sometimes attains a diameter of thirty micromillimeters and is always perfectly spherical.

When the adult stage is reached, the capsule breaks, and one hundred or more spore-like bodies are detached. Locomotion was never observed in the adult forms, nor in the spores. The close resemblance of these spores to coccidia, led to their classification as protozoa.

The lesions produced by their presence in the human body, are chronic suppurating processes. The organism grown upon agar-agar, showed mycelia. Inoculated into guinea pigs, it caused suppurating foci, and the same mould was recovered as had been noted in the patient. The organism was found to develop mycelia, when free in a culture medium such as a hanging drop of bouillon.
—*Medicine.*

Medical Convention.—The annual meeting of the Medical Society of the State of New York was held at Albany, Jan. 29, 30, 31, 1901. Full particulars from A. M. Phelps, M. D., 62 East 34th Street, N. Y. City.

MICROSCOPICAL SOCIETIES.

Quekett Microscopical Club.—The 380th ordinary meeting of this club was held on Friday, Oct. 19, at 20 Hanover-square. Mr. George Massee, F. L. S., president, in the chair. Messrs. Swift exhibited their new portable microscope as shown at a previous meeting, with the addition of their roller detachable mechanical stage and a sub-stage condenser for use with the lower powers, and of such a focus as to give dark-ground illumination through a fairly thick water trough.

Mr. D. J. Scourfield exhibited and described Mr. Ashe's camera-lucida, a form of Beale's well-known form, but which, by the introduction of a small mirror, obviates the drawback of the latter instrument, which inverts but does not transpose the image. Moreover, the drawing can be made at any angle of inclination of the microscope by the use of an inclinable table for the paper. Mr. Lewis communicated some interesting observations made by Mr. E. G. Wheler, on "A Remarkable Stigmatic Organ in the Nymph of *Ornithodorus Megnini*," and also on "*Ixodes tenuirostris*." Specimens and drawings were exhibited, Mr. D. J. Scourfield read a paper on "The Swimming Peculiarities of *Daphnia* and its Allies, with an account of a New Method of Examining Living Entomostraca, &c."

NEW PUBLICATIONS.

Laboratory Directions for Beginners in Bacteriology. Moore, Veranus A. Boston. Ginn & Co., 1900. The cordial reception tendered to the first edition of Dr. Moore's *Laboratory Directions for Beginners in Bacteriology* has caused the author to prepare a second edition. This edition is somewhat extended, and the literature thoroughly sifted. The course is certainly an excellent one and for a course of medium length has enough details to give the student a comprehensive idea of the subject. The work can be recommended most cheerfully to those pursuing a course in bacteriology.—L. H. PAMMEL.

THE ASA GRAY BULLETIN.

A bi-monthly Journal of Botany, devoted to the interests of teachers, students and amateurs. Especial attention is given to **EDIBLE** and **POISONOUS MUSHROOMS** and other **CRYPTOGAMS**. Prominent teachers of botany, specialists, and amateurs, from all parts of the country, are among its contributors. Subscription price only 50 cents per year. Write for special clubbing rates to members of Reading Circles, College Clubs and Mycological Societies. Address:

The Asa Gray Bulletin, Takoma Park, D. C.



**Acute and Chronic Rheumatism,
Neuralgia and Bout.**

Each Plaque Contains the Equivalent of:—Methyl Salicylate, gr. iv; Ext. Leopard's bane, gr. $\frac{1}{4}$; Ext. Rich weed, gr. $\frac{1}{4}$; Tinct. Trailing sunac, M. $\frac{1}{2}$; Ext. Felon wort, gr. j; Colchicin, gr. $\frac{1}{1000}$; Powd. Gargel, gr. $\frac{1}{2}$. They contain no opium nor other narcotic. Full particulars concerning administration with each package. Owing to the costliness of some of the ingredients of these Plaques, No Free Samples can be furnished. Send 25 cts. coin or stamps, for a liberal sample, or send a \$1.00 Bill for 100 Doses to the

HOWARD PHARMACAL CO.

ST. LOUIS, MO.

INVOLUNTARY SEMINAL EMISSIONS
can be POSITIVELY, SPEEDILY and PERMANENTLY
Corrected by the use of
EMISSINE

Put up in Gelatine-coated pill form. Dose ;— One, three times per day. Sample cartoon, containing 20 pills, with formula, will be sent to physicians on receipt of 50 cents.

St. Louis Pharmaceutical Co.,
St. Louis, Mo.

“OCCULT TRUTHS.”

The truths which held and acted upon cure all sick bodies, empty purses, unhappiness and folly are veiled from the minds of those who most need to use them, hence called occult.

It is ours to point the way to this hidden knowledge of life and destiny. The sick, the poor, the unhappy, and those indulging wrong passions, feelings, thoughts or desires will not easily believe occult truths and phenomena. If they would do as directed their troubles must cease.

Published monthly at one dollar per year by CHAS. W. SMILEY, Washington, D. C.

Ten cents paid for a Sample Copy will apply on subscription.

Assistance to Editors and Authors.

The Surgeon General's Library maintained by liberal appropriations of Congress, contains the completest collection of books, serials and pamphlets on medical and allied subjects in the whole world. I am prepared to assist authors and specialists in the profession by making researches, references and bibliographies in this great library. Terms moderate, made known upon request, when the nature and extent of the service required has been specified.

Address: WILLIAM C. DOBSON, M. D.

EDITOR MICROSCOPICAL JOURNAL, WASHINGTON, D. C.

THE AMERICAN

MONTHLY

MICROSCOPICAL JOURNAL.

Entered at the post-office as second-class matter.

VOL. XXII. FEBRUARY, 1901. NO. 2.

CONTENTS.

Recent Knowledge of the Bubonic Plague. William C. Dobson, M. D.....	31-42
Actinocyclus Ralfsii. Nelson.....	44-49
Limitations of Clinical and Microscopical Evidence. Jacques.....	49-57
NOTES BY L. H. PAMMEL.—Auto-intoxication; Karyokinesis; Bubonic Plague; Plant Hybridization; Starches	42-44
MICROSCOPICAL MANIPULATION.—Angle of Microtome Knife; Patches on Sycamore Leaves; Micro-chemical Proof of Copper;.....	57-58
NEW PUBLICATIONS.—Microscopy of Drinking Water; Text-Book of Inorganic Chemistry; A Microscopical Analysis of Powdered Drugs	58-60

Recent Knowledge of the Bubonic Plague.

BY WILLIAM C. DOBSON, M. D.

This article includes also a review of the recently published *Text-Book upon the Pathogenic Bacteria, for Students of Medicine, and Physicians*, By Joseph McFarland, M. D., Professor of Pathology in the Medico-Chirurgical College, Philadelphia. Third Edition, Revised and Enlarged. 8vo. pp. 621. Illustrated with 142 Engravings and 3 plates. Philadelphia, W. B. Saunders & Co. 1900. Price \$3.25 net.

Part I of this work devotes a chapter to each of the following subjects, viz. Bacteria; Biology of Bacteria; Infection and Intoxication; Immunity and Susceptibility; Methods of Observing Bacteria; Sterilization and Disinfection; Cultivation of Bacteria; Cultures and their Study;

The Cultivation of Anaerobic Bacteria ; Experimentation upon Animals ; The Recognition of Bacteria ; Bacteriologic Examination of the Air ; Bacteriologic Examination of Water ; Bacteriologic Examination of Soil.

Part II Considers Specific Diseases and Their Bacteria. This division includes The Phlogistic Diseases, both acute and chronic ; The Toxemias ; The Bacteremias ; Miscellaneous diseases which are not included in the foregoing classifications. The Acute Inflammatory Diseases of Suppuration, Gonorrhoea, Mumps, Cerebro-spinal Meningitis and Pneumonia are ably handled and the chapters devoted to Tuberculosis, Leprosy, Glanders, Syphilis, Actinomycosis, Mycetoma, Farcin du Boeuf and Rhino-scleroma are of especial interest. The Toxemias of Tetanus, Hydrophobia, Diphtheria and Cholera, are brilliantly treated and lead to special articles upon Anthrax, Typhoid Fever, Yellow Fever, Chicken-cholera, Hog-cholera, Swine-Plague, Typhus Murium, Mouse-Septicemia, Relapsing Fever, Bubonic Plague, Tetragenus, Influenza, Measles and Malta Fever, which are calculated to show the education, research and experience of the author. The illustrations are admirably executed and the text excellent, two qualities, which when combined with scholarly classification, tend to produce a volume, of which the publisher may justly feel proud. We are pleased to quote at length from the article on *Bubonic Plague* ; which disease is caused by the *Bacillus Pestis Bubonicae*.

Plague, malignant poly-adenitis, is an acute febrile disease of an intensely fatal nature, characterized by inflammation of the lymphatic glands, marked cerebral and vascular disturbance, and the presence of the specific bacillus in the lymphatic glands and blood. The bubonic plague is an extremely fatal disease, whose ravages in the hospital in which Yersin made his observation, carried off 95 per cent of the cases. The death-rate varies in different epidemics from 50-90 per cent. In the epidemic at Hong

Kong in 1894 the death-rate was 93.4 per cent for Chinese; 77 per cent for Indians; 60 per cent for Japanese; 100 per cent for Eurasians, and 18.2 per cent for Europeans.

It affects both men and animals, and is characterized by sudden onset, high fever, prostration, delirium, and the occurrence of lymphatic swellings—buboes—affecting chiefly the inguinal glands, though not infrequently the axillary, and sometimes the cervical, glands. Death comes on in severe cases in forty-eight hours. If the case is of longer duration, the prognosis is said to be better. Autopsy in fatal cases reveals the characteristic enlargement of the lymphatic glands, whose contents are soft and sometimes purulent. Wyman in his very instructive pamphlet, "The Bubonic Plague," finds it convenient to divide plague into (a) bubonic or ganglionic; (b) septicemic; and (c) pneumonic forms. Of these the bubonic form is most frequent and the pneumonic form most fatal. The infection usually takes place through some peripheral lesion, but may occur by inhalation of the specific organisms. The bacillus of bubonic plague seems to have met an independent discovery at the hands of Yersin and Kitasato in the summer of 1894, during the activity of the plague then raging at Hong Kong. There seems to be but little doubt that the micro-organisms described by the two observers are identical. The bacillus is short and thick—a cocco-bacillus, as some call it—with round ends. Its size is small (2 mm. in length) and its form is subject to considerable variation. It not infrequently occurs in chains of four or six or even more, and is occasionally encapsulated. It shows active Brownian movement, which probably led Kitasato to consider it motile, while Yersin did not.

Gordon found that some, at least, of these plague bacilli have flagella. It is an ærobic organism. No spores are formed. It stains well by the usual method; not by Grams method. When stained the organism appears dark-

er at the ends than at the centre, so as to resemble a dumb-bell or diplococcus. The bacilli sometimes appear vacuolated and in old cultures show a variety of involution-forms. Kitasato has compared the bacillus to that of chicken cholera. In his studies of plague, Ogata states that while Kitasato found the bacillus which he had described, in the blood of cadavers, Yersin seldom found his bacillus in the blood, but always in the enlarged lymphatic glands. Kitasato's bacillus retains the color when stained by Gram's method ; Yersin's does not. Kitasato's bacillus is motile ; Yersin's, non-motile. The colonies of Kitasato's bacillus when grown upon agar are round, irregular, grayish-white with a bluish tint, and resemble glass-wool when slightly magnified ; Yersin's bacillus forms white, transparent colonies with iridescent edges. Ogata, in the investigation of the cases that came into his hands, found a bacillus that resembled that of Yersin, but not that of Kitasato, and it is certain that the description of Yersin is the more correct of the two.

In the *Japan Times*, 1899, Kitasato explains that his investigations being made upon cadavers that were partly putrefied, he was led to believe that the bacillus first invaded the blood. Later studies upon living subjects, showed him the error of this view and the correctness of Yersin's observation that the bacilli first multiply in the lymphatics. The studies of Kitasato and Yersin show that in blood drawn from the finger tips and in the softened contents of the glands, the bacillus may be demonstrable. When cultures are made from the blood or softened contents of the buboes, the bacillus may be obtained in pure culture, and is found to develop upon artificial culture-media. In bouillon, a diffuse cloudiness results from the growth, as observed by Kitasato, though in Yersin's observations the culture more nearly resembled erysipeles cocci, and contained zooglea attached to the sides and at the bottom of the tube of nearly clear

fluid. According to Haffkine, when an inoculated bouillon culture is allowed to stand perfectly at rest, on a solid shelf or table, a characteristic appearance develops. In from twenty-four to forty-eight hours, the liquid remaining limpid, flakes appear underneath the surface, forming little islands of growth, which in the next twenty-four to forty-eight hours grow down into a long stalactite-like jungle, the liquid always remaining clear. In four or six days the islands are still more compact and solidified. If the vessel be disturbed, the islands fall like snow and are deposited at the bottom, leaving the liquid above clear. Upon the gelatin plates at 22°C. the colonies may be observed in twenty-four hours by the naked eye. They are pure white or yellowish white, spherical in the deep gelatin, flat upon the surface, and are about the size of a pins' head. The gelatin is not liquefied.

The borders of the colonies are, upon microscopic study, found to be sharply defined and to become more granular as their age increases. The superficial colonies occasionally are surrounded by a fine, semi-transparent zone. In gelatin puncture-cultures the development is scant. The medium is not liquefied; the growth takes place in the form of a fine duct, little points being seen on the surface, and in the line of puncture. Sometimes fine filaments project into the gelatin from the central puncture. Upon agar-agar the bacilli grow freely but slowly, the colonies being whitish in color, with a bluish tint by reflected light, and first appearing to the naked eye when cultivated from the blood of an infected animal, after about thirty-six hours incubation 37 °C. Under the microscope they appear moist, with rounded, uneven edges.

The small colonies are said to resemble little tufts of glass-wool, the larger ones have large round centres. Microscopic examinations of the bacilli grown upon agar-agar, reveals the presence of long chains resembling streptococci.

Upon glycerin-agar the development of the colonies is slower, though in the end the colonies attain a larger size than those grown upon plain agar. Klein says that the colonies develop quite readily upon gelatin made from beef-bouillon (not infusion), appearing in twenty-four hours at 20° C. as small gray, irregularly rounded dots. Magnification shows the colonies to be serrated at the edges and made up of short, oval, sometimes double bacilli. Some colonies contrast markedly with their neighbors in that they are large, or looped threads of bacilli.

The appearance was much like that of the young colonies of the *Proteus vulgaris*. At first these were regarded as contaminations, but later he was led to believe that their occurrence was characteristic of the plague bacillus. The peculiarities of these colonies cannot be recognized after forty-eight hours. Involution-forms on partly desiccated agar-agar not containing glycerin, are said by Haffkine to be characteristic. The microbes swell up and form large, round, oval, pea- or spindle-shaped or biscuit-like bodies, which may attain twenty times the normal size, and in growing, gradually lose the ability to take up the stain. Such involution-forms are not seen in liquid culture. Hankin and Leumann recommend for the differential diagnosis of the plague bacillus, the addition of 2.5 to 3.5 per cent of salt to the agar-agar. When transplanted from the ordinary agar-agar to the salt agar-agar, the involution-forms which are so characteristic of the plague bacillus, form with exceptional rapidity. In bouillon with this high percentage of salt, the stalactite formation is very beautiful and characteristic. Upon blood-serum, the growth at the temperature of the incubator is luxuriant. It forms a moist layer of a yellowish-gray color, and is unaccompanied by liquefaction of the serum. Upon potato, no growth occurs at ordinary temperature.

When the potato is put for a few days in the incubator, a scanty, dry, whitish layer develops. Abel found the

best culture medium to be 2 per cent alkaline pepton solution with 1 or 2 per cent of gelatin, as recommended by Yersin and Wilson. The bacillus develops under conditions of aerobiosis and anærobiosis. In glucose-containing media it does not form gas. No indol is formed. Ordinarily the culture-medium is acidified by the development of an acid that persists for three weeks or more. By frequent passage through animals of the same species, the bacillus increases very much in virulence. Curiously enough, however, the observations of Knorr, substantiated by Yersin, Calmette, and Borrel, show that the bacillus made virulent by frequent passage through mice, is not increased in virulence for rabbits. Mice, rats, guinea-pigs, rabbits, monkeys, dogs and cats are all susceptible to inoculation. During epidemics, the purely herbivorous animals usually escape, though oxen have been known to die of the disease. When blood, lymphatic pulp, or pure cultures are inoculated into them, the animals become ill in from one to two days, according to their size and the virulence of the bacillus. Their eyes become watery, they begin to show disinclination to take food or to make any bodily effort, the temperature rises to 41.5°C., they remain quietly in a corner of the cage, and die with convulsive symptoms in from two to seven days. If the inoculation was intravenous, there is no lymphatic enlargement, but if it was subcutaneous, the nearest lymph-nodes are always enlarged, and, in cases with delayed death, suppurated. The bacilli are found everywhere in the blood, but not in very large numbers.

Devell has found that frogs are susceptible to the disease. Wyssokowitz and Zabelotny found monkeys to be highly susceptible to plague, especially when inoculated subcutaneously. When so small an inoculation was made as a puncture with a pin, dipped in a culture of the bacillus, the puncture being made in the palm of the hand or sole of the foot, the monkeys died in from three to seven

days. In these cases, the local edema observed by Yersin, did not occur. They point out the interest attaching to infection through so insignificant a wound and without local lesions. According to Yersin, an infiltration of watery edema can be observed in a few hours, about the point of inoculation. The autopsy shows the infiltration to be made up of a yellowish gelatinous exudation. The spleen and liver are enlarged, the former often presenting an appearance, much like an eruption of miliary tubercles. Sometimes there is universal swelling of the lymphatic glands. Bacilli are found in the blood and in all the internal organs. Very often there are eruptions during life, and upon the inner abdominal walls there are petechiæ and occasional hemorrhages. The intestine is hyperæmic, the adrenals congested. There are often sero-sanguinolent effusions into the serous cavities.

Klein found the intra-peritoneal injection of the bacillus into guinea-pigs, of diagnostic value, producing in twenty-four to forty-eight hours a thick, cloudy peritoneal exudate, rich in leucocytes and containing characteristic chains of the plague bacillus. Animals fed upon cultures or upon the flesh of other animals dead of the disease, became ill and died with typical symptoms. When Klein inoculated animals with the dust of dwelling houses in which the disease had occurred, some died of tetanus, one from plague. Many rats and mice in which examinations showed the characteristic bacilli, died spontaneously in Hong-Kong. Yersin showed that flies also die of the disease. Macerating and crushing a fly in bouillon, he not only succeeded in obtaining the bacillus from the medium, but infected an animal with it. Nuttall in reviewing Yersin's fly experiment, found the statement true, and showed that flies fed with the cadavers of plague infected mice, died in a variable length of time. Large numbers of plague bacilli were found in their intestines. He also found that bed-bugs allowed to prey upon infected

animals, took up large numbers of the plague bacilli and retained them for a number of days. These bugs did not, however, infect healthy animals when allowed, subsequently, to feed upon them. Nuttall is not, however, satisfied that the number of his experiments upon this point was great enough to be conclusive. Ogata found that the plague bacillus existed in the bodies of fleas found upon diseased rats. One of these he crushed between sterile object-glasses and introduced into the subcutaneous tissues of a mouse, which died in three days with typical lesions of the plague, a control animal remaining well.

The guinea-pigs taken for experimental purposes into a plague district, and kept carefully isolated, died spontaneously of the disease, presumably because of insect infection. The animal most prone to spontaneous infection seems to be the rat, and there is much evidence in support of the view, that it aids in the spread of epidemics. At several of the Asiatic plague districts and at Santos the appearance of plague among the inhabitants was preceded by a large mortality among the rats, some of which when examined, showed buboes and had died of plague-septicemia. It is rather improbable that men become infected with plague through the bites of the fleas, leaving the bodies of plague-destroyed rats, as was once supposed. Galli-Valerio thinks the fleas of the mouse and rat are incapable of living upon man and do not bite him, and that it is only the *Pulex irritans*, or human flea, that is capable of transmitting the disease from man to man. Yersin found that when cultivated for any length of time upon culture media, especially agar-agar, the virulence was rapidly lost and the bacillus eventually died. On the other hand, when constantly inoculated from animal to animal, the virulence of the bacillus is much increased.

The bacillus probably attenuates readily. Kitasato says that it did not seem able to withstand dessication, longer than four days; but Rappaport (quoted by Wyman) found

that they remained alive when kept dry upon woolen threads at 20 °C. for twenty-three days and Yersin found that although it could be secured from the soil beneath an infected house, at a depth of 4-5 cm., the virulence of such bacilli was lost. Kitasato found that the bacilli was killed by two hours exposure to 0.5 per cent. carbolic acid, and also by exposure to a temperature of 80 °C. for five minutes. Ogata found that the bacillus was instantly killed by 5 per cent carbolic acid, and in fifteen minutes by 0.5 per cent carbolic acid. In 0.1 per cent sublimate solution it is killed in five minutes. According to Wyman, the bacillus is killed by exposure to 55° C. for ten minutes. The German Plague Commission found that the bacilli were killed by exposure to direct sunlight for three or four hours; and Bowhill found that they were killed by drying at ordinary room temperatures in about four days. It seems possible to make a diagnosis of the disease in doubtful cases by examining the blood, but it is admitted that a good deal of bacteriologic practice is necessary for the purpose. Abel finds that the blood may yield fallacious results because of the rather variable appearance of the bacilli, which are sometimes long, and easily mistaken for other bacteria. He deems the best tests to be the inoculation of broth cultures and subsequent inoculation into animals, which he advises should have been previously vaccinated against the streptococcus.

Plague bacilli persist in the urine a week after convalescence. Wilson, of the Hoagland Laboratory, found the thermal death-point of the organism was one or two degrees higher than that of the majority of pathogenic bacteria of the non-sporulating variety, and that, unlike cholera, the influence of sunlight and desiccation cannot be relied upon to limit its viability. Dr. Kitasato's experiments first showed that it is possible to bring about immunity to the disease, and Yersin, working in India, and Fitzpatrick in New York, have successfully immunized

large animals (horses, sheep, goats). The serum of these immunized animals contains an antitoxin capable not only of preventing the disease, but also of curing it in mice and guinea-pigs and probably in man. Haffkine in his experiments followed the line of preventive inoculation as employed against cholera. Bouillon cultures were used, in which floating drops of butter were employed to make the islands of plague bacilli float. The cultures were grown for a month or so, successive crops of the island-stalactite growth as it formed, having been precipitated by agitating the tube. In this manner there was obtained an "intense extra-cellular toxin" containing large numbers of the bacilli. The culture was killed by exposure to a temperature of 70 °C. for one hour, and the mixture used in doses of about 3 c.cm. as a preventive inoculation.

A most interesting collection of statistics, showing in a convincing manner the importance of the Haffkine prophylactic, is that of Leumann of Hubli. The figures, together with a great deal of interesting information upon the subject, can be found in the paper upon "A Visit to the Plague Districts in India" by Barker and Flint. The immunity conferred by the Haffkine prophylactic in doses of 1 c.cm. is of considerably longer duration, lasting about a month. The preparation must not be used if the persons have already been exposed to infection, and is possibly in the incubation stages of the disease, as it contains the toxins of the disease and greatly intensifies the existing condition. When injected into healthy persons it always produces fever, local swelling and malaise. Wyssokowitz and Zabolotny, whose studies have already been quoted, used 96 monkeys in the study of the value of the "plague-serums," and found that when the treatment has begun within two days from the time of inoculation, the animals can be saved, even though symptoms of the disease are marked. After the second day, the treatment cannot be relied upon. The dose necessary was 20 c. cm. of

a serum having a potency of 1 : 10. If too little serum was given, the course of the disease was slowed, the animal improved for a time and then suffered a relapse, and died in from thirteen to seventeen days. The serum also produced immunity, but of only ten to fourteen days duration.

An immunity lasting three weeks was conferred by inoculating a monkey with an agar-agar culture heated to 60 °C. If too large a dose of such a culture was given, however, the animal was enfeebled and remained susceptible. Of Yersin's serum, which is prepared by immunizing horses in the usual manner to toxins and cultures of the bacillus, 5 c. cm. doses have been found to confer an immunity lasting for about a fortnight. Larger doses confer a longer immunity. For the treatment of the developed disease, enormous doses of 50 and even 100 c. cm. seem to be necessary to produce the desired results, evidently indicating that the serums thus far obtained are weak.

BIOLOGICAL NOTES.

L. H. PAMMEL.

AUTO-INTOXICATION AND SPIROGYRA.—In a recent number of the American Journal of the Medical Sciences, Dr. Klingmann makes some interesting statements with reference to auto-intoxication and toxic states of blood. He has experimented with protozoæ and algæ, which were treated with various toxic substances. The alga used was Spirogyra. After describing briefly the normal peculiarities of Spirogyra, he shows that toxic substances like those produced in certain contagious diseases, and those following epilepsy, produced certain pathological changes in the Spirogyra.

“The water which is used for diluting the blood is tested by placing a few threads of Spirogyra in a glass dish

containing some of the water, and is allowed to stand for a few minutes; if the water is non-toxic the specimen remains unchanged. The time in which the change will occur varies directly with the amount of toxin present and the species of *Spirogyra* used. In one case it was found that reaction took place after diluting the blood with five litres of water. In this way it can be determined whether the toxicity of the blood has increased or diminished. It was repeatedly observed that in testing the blood of patients who were convalescing, the time in which the reaction took place was greatly prolonged; in one case of diphtheria, this was noticed after two injections of antitoxin. In all cases examined, except those suffering from acute or chronic alcoholism and gout and rheumatism, a division of the protoplast of the *spirogyra* took place; in the cases of alcoholism, rheumatism and gout, the reaction was not the same as that occurring in the other cases, but resembled that described by Naegeli under the second heading; the chlorophyll bands were retracted from the protoplasmic cylinder and changed their general arrangement, and the nucleus changed its position and form." (*Am. Jour. Med. Sci.* 120:585.)

KARYOKINESIS.—In the October number of the *Popular Science Monthly* (57:664:1900) there is published the retiring address of Sir William Turner as President of the British Association. This paper considers the history of cytology, especially with reference to the multiplication of cells and karyokinesis. Those who are especially interested along this line will find this paper presenting the subject in a most admirable and concise form.

BUBONIC PLAGUE.—In the October number of *Popular Science Monthly*, (57:576. 1900), Dr. Frederick G. Novy discusses the Bubonic Plague. This paper deals chiefly with historical matters showing how the disease has spread to the various parts of the world at different times.

PLANT HYBRIDIZATION.—Mr. Herbert J. Webber who has charge of the plant breeding laboratory of the U. S. Department of Agriculture, has been making some interesting observations along the line of hybridization. Among the other plants studied he has done something with the pineapple ; he finds that some varieties are much more fertile than others. "In my own experience, the most fertile varieties are the Abbaka and Smooth Cayenne, two of the finest varieties known. Ninety-seven flowers of Abbaka crossed with pollen of Smooth Cayenne gave seventy-seven good seeds, and, in the case of the reciprocal cross, thirty-six flowers of the Smooth Cayenne crossed with pollen, Abbaka gave forty-six perfect seeds. Other sorts used in crossing, such as Golden Queen, Ripley, Red Spanish, Mauritius, &c., gave varying degrees of fertility between these two extremes." (Separate Jour. Roy. Hort. Soc. 24.)

STUDY OF MANUFACTURED STARCHES.—In a recent bulletin of the Division of Chemistry, U. S. Department of Agriculture, Dr. Wiley discusses the manufacture of starch from potatoes and cassava and incidentally refers to the structure of microscopic characters of a number of other starches, and the amount of starch produced in the different plants. He also discusses the methods of manufacture. This paper is accompanied with several excellent plates. (Bull. Div. Chem. U. S. Dept. Agrl. 58.)

Actinocyclus Ralfsii.

EDWARD M. NELSON, F. R. M. S.

The interesting diatom, especially when viewed under a low power, is so transcendently beautiful that it will attract the attention of even those who, like Gallio, "care for none of these things." The charm in this diatom consists not only in its remarkable system of rays, from which it derives its name, but also in its exquisite coloring.

When, however, this diatom is viewed in a critical manner with a wide-angled oil-immersion lens all its lovely color vanishes and its beautiful rays become so inconspicuous as to be hardly noticeable; in spite of this, however, its interest to a scientist will be rather increased than diminished. It is not difficult to account for the loss of the rays, for when the diatom is examined under a low power, the dots, or more accurately the minute perforations in the siliceous wall, are so closely approximated to one another that they appear to run together and form rays, but when this structure is examined under a higher power of greater aperture, these dots are so widely separated that they cease to give this appearance of lines or rays.

The reason for the loss of the color is not quite so obvious, for the color may be produced in a variety of ways e. g. by polarization, by the unequal refraction of light, by diffraction, by the varying thickness of transparent thin plates, and lastly by pigments. Now we know that exceedingly minute objects, such as bacteria and micrococci, when stained by pigments do not lose their color when examined by high powers; but on the other hand, objects such as diatoms, which owe their color to the diffraction of light by their minute structure, change their color from violet to red and finally lose it altogether as the power, or rather the aperture, of the objective is increased. It is an instructive experiment to examine with dark ground illumination and a low-power objective, say one inch or $\frac{3}{4}$ inch of aperture .25 to .3 N. A., a slide containing various species of *Pleurosigma* that have different degrees of fineness of structure; the coarser forms will appear ruddy, those a little finer, greenish, those still finer blue, and some finer still, will appear violet or indigo.

Now if the lens be changed for one whose aperture is .4 N. A., those that were ruddy will be colorless, and the structure that gave rise to the color will be resolved, those that were green will be ruddy, and those that were blue

will have become green, and so on. If a lens of still greater aperture be employed, those that were originally green will become colorless and will be resolved, and the colors of the others will be lowered a step in the gamut. This law, which holds good with other diatoms, quite breaks down with the *Actinocyclus Ralfsii*, for if we examine one on a dark ground with a low power those parts which were brilliantly colored blue with transmitted light now become a golden yellow. Again, all other diatoms lose their color when the structure which gives rise to it by diffraction is resolved, but with *A. Ralfsii* the color remains, although the structure is resolved, and lastly other diatoms when viewed by axial transmitted light appear white, while this is brilliantly colored, provided that a lens of suitable aperture be employed to examine it. The color in this diatom is visible with transmitted light, provided that the aperture of the objective used does not greatly exceed .45 N. A.; the power of the objective or eyepiece is of no consequence, the aperture of the lens is the sole determining factor in the case, as may be proved by manipulating an iris diaphragm at the back of the objective.

There is a slide in my cabinet which contains both an *Actinocyclus Ralfsii* and a *Hyalodiscus stelliger*. This last diatom has an ordinary sieve-like structure of about 35,000 per inch. Now, these two diatoms act in precisely contrary manners, for on a light field with ordinary transmitted light the *Actinocyclus* is brilliantly colored while the *Hyalodiscus* is colorless; but on a dark ground the *Hyalodiscus* is colored, and the *Actinocyclus* colorless. In short, the *Hyalodiscus* follows the rule of all other diatoms, e. g., the *Pleurosigmæ*, *Naviculæ*, etc., and behaves precisely like them. In *Actinocyclus Ralfsii* the only part which follows this general diatomic rule is the narrow margin which, with transmitted light, is a golden yellow. (This color may be somewhat erroneously described, as its

golden tint may be caused by the contrast with the brilliant blue close to it), but on a dark ground exhibits a blue-green tint; this is a diffraction color, which like all diffraction colors, turns white on resolution, or more strictly speaking shortly before resolution.

The tint of the diffraction color of a diatom depends upon the aperture of the objective used, and the obliquity of the illumination. By this means we may therefore roughly determine the fineness of any diatomic structure by matching the tint with one whose fineness of structure has been measured, or with a test plate or ruled bands.

Of course it is necessary that the comparison be made with the same objective and under the same conditions of illumination. A suitable illumination for this purpose is daylight, and an achromatic condenser with a central opaque stop, just large enough to give a dark ground.

The question then is: what is the cause of the color in *Actinocyclus Ralfsii*? Obviously it cannot be a diffraction color arising from the ordinary primary structure forming the "rays," which give the diatom its name, because as we have seen above, when this structure is resolved the color is still visible, and no color arising from diffraction is visible when the diffraction itself is resolved. It cannot be due to pigment, for if it were it would remain visible when the aperture was increased beyond .45 N.A. It cannot be caused by thin plates, because it would require reflected and not transmitted light to render it visible. Polarization and refraction seem quite out of the question; and as there is no other theory at hand, the answer must for the present be left undetermined.

It was pointed out in 1897 (Journ. Q. M. C., Vol. 6, ser. 2, p. 431) that with an apochromatic $\frac{1}{4}$ of 1.4 N.A., used in connection with a wide-angled oil-immersion condenser giving a large aplanatic cone, a very delicate perforated veil could be seen covering the whole valve of an *Actinocyclus Ralfsii*. This very delicate structure has ob-

vously nothing to do with the color in question, because it would require a far greater aperture than .45 N.A. to develop upon a dark ground, any color arising from the diffraction of so fine a grating ; and this question is quite independent of that concerning the different kind of illumination required to develop the color, a point of which we have as yet found no explanation. If a *Hyalodiscus subtilis* whose structure is about 70,000 per inch, or twice as fine as that of *Hyalodiscus stelliger*, be examined on a dark ground with a lens of .25 N.A. no color will be perceived, while the *H. stelliger* under similar conditions will be brightly colored ; if the aperture be increased to .5 or .6 the *H. stelliger* will be resolved, while the color of the *H. subtilis* will be an intense blue. Now the resolution of the *H. subtilis* may be accomplished with a dry lens of .95 N.A., used critically, but as this lens reveals nothing of the extremely delicate structure we are considering on *Actinocyclus*, it stands to reason that the color, observed in *Actinocyclus* with quite a low aperture and with transmitted light, cannot possibly be caused by this delicate structure. To repeat the argument :—

HYALODISCUS SUBTILIS.

This diatom when viewed upon a dark ground, with a lens whose aperture is .55 N.A., is colored ; the structure which gives rise to this color can be resolved by a dry lens of .95 N.A.

ACTINOCYCLUS RALFSII.

This diatom when viewed by transmitted light, with a lens whose aperture is .25 N.A., is colored ; the color remains when the coarse structure on the diatom is resolved ; a dry lens of .95 N.A., however critically used, is quite unable to resolve the fine veil on this diatom. If this fine veil were the diffractor which caused the coloration of this diatom, it would require a lens with an aperture of at least .55 N.A. to develop the color.

Finally, all diffraction colors vanish with transmitted

light, but the color of *A. Ralfsii*, with exception of that on its narrow margin, is only visible with transmitted light.

In this narrow margin the single process or nodule is situated; this I find has a very finely perforated cap, very similar to those of the Aulisci which have been previously described. The resolution of this detail is exceedingly troublesome, and perhaps it is one of the most difficult images the microscope, as at present constituted, is capable of dealing with.—*The Quekett Club*.

The Limitations of Clinical and Microscopical Evidence.

W. K. JACQUES, M. D., CHICAGO.

To correctly interpret the phenomena of disease and health, one must have a clear conception of the relationship sustained by pathogenic bacteria in the causation of disease. The older bacteriologists, led by the great Robert Koch, believed and taught that germs were the cause of disease, using the word cause in its scientific sense. That is to say, that within the germ are all the elements which are manifest in the effect, disease. This was in direct opposition to the teachings of Virchow's cellular pathology. Between these great leaders and their followers, has waged a long war, with the gradual evolution of the fact that both are partly right.

Disease is a process brought about by many factors, no one of which may be the all sufficient cause, any more than the electric spark may be the all sufficient cause of a dynamite explosion.

The germ is many times the exciting cause, or the last factor added to set the disease process in motion. The Klebs-Löffler bacillus, the pneumococci and other microorganisms may be carried in the mouth of a healthy individual for long periods of time without becoming pathogenic, until the individual becomes susceptible through lowered vitality and the disease process is set in motion.

In these cases, predisposition is the last factor added. The germ is not the all sufficient cause, but is an important factor, capable of setting the disease process in motion and of influencing it when other factors are present. It is only when the relationship is recognized, that the limitations of the microscopic and clinical evidence in diagnosis can be understood. A germ disease is where the patient furnishes the conditions under which a germ can multiply and by its presence, or products, disturb the metabolism of the human cells. When the environment of the cells furnishes them with proper conditions, the resulting metabolism is a condition of health.

When there is introduced into this environment anything which depresses or stimulates the metabolism of the cells beyond normal limits, the resulting condition is called disease. Therefore it is important to understand those things which go to make up environment.

Temperature, food, the products of cell activity—such as the ductless glands—and poisons of various kinds, are factors of environment whose presence or absence may cause disease metabolism. The cell, therefore, is the dominant entity of life. From its environment it receives nourishment and the necessary stimulus which causes it to absorb, excrete and reproduce its kind. The bacterial cell does not differ in these essentials from the human cell. It is a living entity and its internal metabolism depends upon its environment. When the pathogenic germ finds in the human body, conditions which permit it to carry on its cycle of activity, its presence becomes a factor in the environment of the human cells, which causes disease metabolism. In the study of infectious diseases, it is important to recognize the individuality of the different pathogenic germs. Each is subject to governing laws, as definite as those concerning the human being.

Each germ by its form and structure and its former environment, possesses individual pathogenic power. All

micro-organisms are most susceptible to the environment.

Their life cycle is so short that they are able to adapt themselves to changing conditions much more readily than is possible in the animal cells. What is true of one germ, may or may not be true of another; each has its own range of temperature, food conditions and environment in which it becomes pathogenic or harmless. The effects of environment may be demonstrated by placing germs under different conditions and noting the results.

Most students are familiar with the results of growing the Loeffler bacilli on agar agar and other media. The bacilli of anthrax vary greatly under different conditions.

Prof. Adami has shown how the bacillus colli changes from the bacillus form to the coccus, as it passes through the tissues. Because of these morphological changes, it is difficult to identify germs by form alone. While they may resemble each other in form, they will differ in arrangement, staining qualities, virulence or other conditions. The tissues in which a germ is found growing, may assist in its identification. As knowledge of bacteria progresses, the necessity of not relying upon any one definite quality in identification, becomes imperative. Virulence is even more influenced by environment than form. If the germ metabolism takes place in the presence of free oxygen, the toxin may be oxidized and rendered harmless.

Cholin derived from nerve substance and neurin differ only in a molecule of water. One is but slightly poisonous and the other intensely so. When bacteria are able to break up the highly organized substances of the human body, these atoms at once enter into new combinations under the conditions which then exist. Scientists are realizing the necessity of studying pathogenic germs in the environment in which they produce disease. The student of malaria goes to the swamp, and the investigator of the plague, to Calcutta. In some of the more common germ diseases, it is often important that the microscopical ev-

idence must not be separated from the clinical. The bacteriologist may be able to identify a germ as soon as seen under the microscope, but to be absolutely certain, it is necessary to make cultures and animal tests. The methods are too cumbersome and take too much time for most diagnostic purposes. If the bacteriologist knows the clinical symptoms of the patient at the time the culture was taken, it might remove any uncertainty in the identification of the germ. For instance, a Health Department box was inoculated and sent to a pathological laboratory for examination.

The bacteriologist reported the finding of the diphtheria bacilli. Had the culture been accompanied with the information that it had been inoculated from a healthy vagina, the germ would have been recognized as the bacillus vaginalis. The method of taking the culture is also important. The condition of material sent to the laboratories often shows very careless methods or ignorance of bacteriology. The surface of the medium is scarcely touched with the inoculating swab; cotton swabs come wrapped in newspaper, envelopes, or dirty bottles. Some of the fluids of the body are destructive to germs. When taking blood for examination, it should be at once diluted by large quantities of broth to prevent it from destroying the germs. It is the verdict of the bacteriologist that swabs from suspected anginas should be used at once to inoculate culture media. If this is not done at once, the action of the saliva may destroy the bacilli and thus prevent the detection of their presence.

For this reason, swabs alone cannot be sent by mail. It must be remembered that culture media furnishes a different environment than the human tissues and modifications in the morphology and virulence of germs may occur. Most students of bacteriology know the variations which occur in the Loeffler bacillus when grown on agar agar and blood serum; but it is not so well known that

serum from bovines, causes a short thick bacillus and that from sheep and dogs, a longer one. The tubercular bacillus has been identified by its staining qualities until now almost without question. The recent work of bacteriologists show that other bacilli not only have the same form but the same staining reaction as the tubercular bacillus.

A smear from the prepuce of a dog and one from tuberculous sputa, both prepared and stained by carbolfuchsin method will give a similar field. In the diagnosis of pulmonary tuberculosis in its early stages, the limitations of the microscopic examination, if not understood, may result in serious consequences to the patient. At this stage the tubercular foci may not be in a condition to throw the bacilli into the sputum. They may be in such limited numbers, that they can only be found with difficulty.

If a physician depends upon the negative answer of the bacteriologist, he may let the time pass when it is within the power of any help to stay the tubercular process.

The tuberculin reaction in careful hands is of value, but has not yet reached the stage of application needed for use by the general practitioner. It is generally understood that the term diphtheria is applied to that disease which is caused by the multiplication of the Loeffler bacillus in a susceptible individual. The necessity for giving antitoxin early, forces the physician to make a diagnosis as soon as possible. The rapid multiplication of the bacilli at the point of invasion, the peculiar arrangement, the morphology, which is fairly maintained by the bacilli when growing in culture, in a large per cent of cases make the identification of the germ reliable. It has been a great relief for the physician to unload his cares on the shoulders of the bacteriologist. It seems too bad that the latter is getting tired and insists in returning the responsibility to the family physician, where the patient has placed it. All a bacteriologist can say when ex-

aming cultures, is that he finds a germ corresponding to the Klebs-Löffler bacillus. It is for the physician to complete the diagnosis by putting with it the clinical symptoms and to decide whether or not the disease process is in motion.

There is such a wide range in the morphology of the diphtheria bacillus that it is not easy to identify. There are other germs which resemble it so closely that it is sometimes difficult to distinguish them. The Löffler bacillus may have all grades of virulence. The long variety is the most virulent, yet the short form may be toxic and the non-virulent form cause death by strangulation. The site of the invasion may not be where the germs can be obtained, or antiseptic gargles may have been used.

The culture medium may be contaminated. To properly appreciate the value of microscopical evidence, a physician should be familiar with those conditions which promote accuracy and success. While it would be little short of criminal to discard the use of the microscope in the diagnosis of diphtheria, it should be kept in mind that there are conditions where this evidence may be absent and the patient's life be dependent upon the recognition of the clinical symptoms. The diagnosis of scarlet fever is always important and sometimes difficult.

The rash may be slight and the clinical symptoms not clear. If the physician has made a thorough study of the class coccus in relation to this disease, he will find it of value in making a diagnosis and in protecting susceptible individuals. In this case it is environment which causes malignancy. Scarlet fever is produced only by the multiplication of the infection in the blood of a susceptible individual.

This environment cannot be produced in the laboratory. If bacteriologists will take their microscopes to the scarlet fever patient and study the germ under the conditions in which it causes disease, they will find evidence that it

is the causative germ. When I have found this germ in large numbers in cultures from anginas, I have put the attending physician on his guard and the rash has been observed when it might otherwise have been overlooked. In one case of an adult, the rash was so slight that there was some question about it, but a considerable amount of albumen appeared in the urine ten days after. A congested throat may cause a soil in which the coccus may multiply and produce a severe angina.

If the blood is not susceptible, it remains a local inflammation; if it is, scarlet fever follows. In the diagnosis of gonorrhoea, the microscope is of importance in the acute stage.

It will also show the value of different methods of treatment. Its greatest importance is in the examination of individuals who have had this disease at some remote period and who wish to know, before intended marriage, if the gonococcus is still present. In such cases the clinical symptoms may be entirely absent, but germs may remain for long periods of time in the interstices of the prostate gland, or other parts of the genital tract, in sufficient numbers to infect a female under the conditions of marital relations. By the careful examination of the discharges from these parts, the gonococcus may be found and the unhappy consequences to the future wife averted.

Microscopic evidence is far too often neglected in the diagnosis of influenza. There are saprophytic bacteria living in the human mouth which take on virulence under favorable conditions and produce severe catarrhal disturbances. These germs stand in a similar relation to influenza that the germs causing anginas do to diphtheria. If a correct diagnosis could always be made, the germ would soon assume its proper position as a disease causing factor. Influenza is contagious and should be isolated. Invalids and people of advanced years are susceptible, and it is the duty of the physician to protect them

as he would children from scarlet fever. In the diagnosis of malaria, the assistance of the microscope should not be ignored, but in order to appreciate its value, the life cycle of the plasmodium, its various forms and all the conditions under which it may be found, as well as the various forms of the disease in which it is absent, must be understood. The physician should keep pace with the work of the bacteriologist in order to properly value microscopic evidence.

When the Widal test for enteric fever came out, we were amazed at the accuracy with which it confirmed the diagnosis of typhoid fever. Extended knowledge has demonstrated that it is not infallible. Allowing that in a small per cent of cases the reaction is not present, it is by far the most reliable evidence we have in typhoid diagnosis at the present time. It is to be hoped that further investigation will determine when the reaction is not reliable.

There is a tendency among those physicians who have not had a bacteriological training, to under-estimate the value of microscopical diagnosis.

Influenced by the teaching that the germ is the all sufficient cause of disease, the bacteriologists in the past have claimed too much. To them the germ was the disease. Now that the bacteriologists have had to recede from this position, the doctor who does not use the microscope, believes that it weakens all microscopical evidence. This is not true. Microscopical evidence is of more value than ever before, if the physician has the knowledge to appreciate it. The fact that we have a pseudo-typhoid, a pseudodiphtheria and possibly a pseudo-tubercular bacillus which causes the bacteriologists to hesitate, only emphasizes the necessity of the physician being a closer student of the problem of environment; of the germ which causes virulence, and environment of the patient which causes susceptibility. In a germ disease, there is a battle between

two living entities, or rather two armies of living cells. When pathogenic germs find a human organism weak enough to permit an invasion, the battle is on, each using utmost power to overcome the other. If the human cells are slow to act and the germs, or their products, are able to overcome some vital center, death results. If they respond quickly, antitoxins, phagocytes and digestive products are poured into the blood, the invading germs are overcome, digested and excreted. The existence of the human organism and its ability to complete its life cycle, depends upon its power to maintain germ immunity. The microscope, with careful technique, at times gives results with almost mathematical accuracy, which cannot be claimed for the uncertainties of clinical diagnosis alone.

In the use of the microscope, a physician should keep in mind that most often the greatest safety of his patient, and his own best mental development, comes through the close study of the clinical phenomena of disease. *C Clinic.*

MICROSCOPICAL MANIPULATION.

PROPER ANGLE OF THE MICROTOME KNIFE.—Dr. B. Rawitz (Journ. Micros.) finds from experiment that the microtome knife should be placed at an acute rather than at a right angle. When placed at the latter angle, the sections, according to their thickness, are always more or less crowded together, thus distorting the finer structures of the tissues cut.

PATCHES ON SYCAMORE LEAVES.—If one will examine the under side of a sycamore leaf, he will probably find a number of minute dark brown discs attached to it. These, if carefully transferred to a microscope slide and moistened with a drop of water, or perhaps better, a 50 per cent solution of liq. potassæ, will show with a $\frac{1}{2}$ in. or $\frac{1}{4}$ in. objective, very pretty objects. They belong to the group of

fungi Ascomycetes, popularly known as "Sac fungi," and these particular ones are probably *Uncinulæ necator*, or an ally, others similar are found on Virginia creeper and lilac leaves. If the cover-glass be pressed a little, asci with ascospores may be forced out. Some suppose the black spots on the leaf are due to a fungus; this may be so. I have carefully examined these spots for years, and have never been able to connect the one with the other, and shall be glad to hear more about this interesting microscopical subject.—W.H.D.M.

MICROCHEMICAL DEMONSTRATION OF THE PRESENCE OF COPPER.—For the demonstration of the presence of copper by microchemical means, according to Pozzi-Escot in the *Chemische Zeitung*, two compounds of copper iodide and ammonia are especially suited. An ammoniacal copper oxy-salt solution, decomposed by the addition of potassium iodide, yields a crop of minute blue tetrahedric crystals, with the formula $\text{CuI}_2, \text{NH}_3, \text{H}_2\text{O}$. If to an ammoniacal copper oxy-salt solution, sufficient ammonia be added to dissolve the copper salt by aid of heat, and the same be heated about 40°C ., under the addition of sodium or ammonium iodide, the liquid becomes yellowish green, and brown-black rhombic tablets, whose composition has not yet been established, are thrown down. The substance is probably $\text{CuI}_4 \text{NH}_3$. It is very easily decomposed—disappearing fully within 10 minutes, leaving only yellowish green prismatic tablets to be seen.

NEW PUBLICATIONS.

The Microscopy of Drinking Water.—By George Chandler Whipple. New York, John Wiley & Sons. 1899. pp. 292, Plates xix.

In this work, the historical matters are given, besides a very excellent account of the object of the microscopical examination of water, and the different methods in vogue such

as Sedgwick-Rafter, the Plankton net method, the Plankton pump, the Plankton krit, each of these given in sufficient detail to enable any student to make use of them. In chapter IV the writer considers the microscopic organisms in water from different sources such as rain water, ground water, surface water. The bacteria are largely omitted. There is a brief allusion to them as well as one plate describing the different types. Then the writer takes up the subject of Limnology treating the ponds and lakes, their geology, geography, physics, chemistry, biology and the relation of these to each other. The work is an excellent one and should be in the hands of one who are interested in the study of water and its organisms.—L. H. PAMMEL.

Text Book of Inorganic Chemistry, By Victor von Richter, edited by Prof. H. Klinger of the University of Königsberg, and translated by Edgar F. Smith, Professor of Chemistry in the University of Pennsylvania, Philadelphia. Fifth American from the Tenth German Edition, containing 68 illustrations on wood and a colored lithographic plate of 'Spectra. 8 vo. pp. 430. Philadelphia, P. Blackiston's Son & Co., 1900. Price \$1.75 net.

In presenting this subject to the student, the author has made it a point to bring out prominently the relations existing between fact and theory, which treatment will greatly aid the student in obtaining a thorough knowledge of a highly important science. Ample space has been given to the consideration of the more recent, well-established discoveries in chemical science and valuable additions have been made relating to the general properties and measurement of gases, to the atmosphere and the interesting constituents lately observed in it, to the theory of dilute solutions and electrolytic dissociation, to the electrolysis of salts, to alloys, etc. This work, which reflects credit upon both author and editor, we are pleased to endorse and recommend to the profession and scientific public.

DIE MIKROSKOPISCHE ANALYSE DER DROGENPULVER.—
Microscopical Analysis of Powdered Drugs—An atlas for Apothecaries, Druggists and Students of Pharmacy, by Dr. Ludwig Koch, professor of botany at the University of Heidelberg. First volume, First number. Published by the Brothers Borntraeger, Berlin, 1900. Price 3 marks 50 pfennig (85 cts.), post free.

The contents of this first volume embrace the Cortices and Ligna (barks, peelings and woods) of the German Pharmacopœia, the present issue being devoted to Cortex Aurantii Fructus, Cortex Cascarillæ, and Cortex Chinæ Succirubræ—these being preceded by a general and special introduction, in which the methods of investigation, including preparation of the sample, the media, reagents, etc., are fully set forth, as well as the special microscopical methods of research. There is also a special introductory dissertation on the Cortices of the Pharmacopœia, their anatomical structure, etc.

The work will appear in parts, from time to time, but without fixed periods of issue, until completion, each part costing 3 marks and 50 pfennigs, or say 85 cents of our money. The exact number of issues has not yet been announced. Every apothecary interested in the microscope, and every student of pharmaceutical microscopy should have this work. Nothing like it has ever been issued in any language, and that it is in German, should make but little difference, in this region, at least, where a general knowledge of German is almost universal among the educated classes. The plates alone are worth the money asked for the book.

100 per ct. Profit. No Grain, Stock or Turf Speculation. Full particulars and more sample copies of choice magazines than you could buy for several dollars mailed for 10 cents. West. Per. Sub. Agency, 516 E. F. 2nd Ave., Milwaukee, Wis.

INVOLUNTARY SEMINAL EMISSIONS

can be POSITIVELY, SPEEDILY and PERMANENTLY

Corrected by the use of

EMISSINE

Put up in Gelatine-coated pill form. Dose ;— One, three times per day. Sample cartoon, containing 20 pills, with formula, will be sent to physicians on receipt of 50 cents.

St. Louis Pharmaceutical Co.,
St. Louis, Mo.

“OCCULT TRUTHS.”

The truths which held and acted upon cure all sick bodies, empty purses, unhappiness and folly are veiled from the minds of those who most need to use them, hence called occult.

It is ours to point the way to this hidden knowledge of life and destiny. The sick, the poor, the unhappy, and those indulging wrong passions, feelings, thoughts or desires will not easily believe occult truths and phenomena. If they would do as directed their troubles must cease.

Published monthly at one dollar per year by CHAS. W. SMILEY, Washington, D. C.

Ten cents paid for a Sample Copy will apply on subscription.

Assistance to Editors and Authors.

The Surgeon General's Library maintained by liberal appropriations of Congress, contains the completest collection of books, serials and pamphlets on medical and allied subjects in the whole world. I am prepared to assist authors and specialists in the profession by making researches, references and bibliographies in this great library. Terms moderate, made known upon request, when the nature and extent of the service required has been specified.

Address: WILLIAM C. DOBSON, M. D.

EDITOR MICROSCOPICAL JOURNAL, WASHINGTON, D. C.

THE ASA GRAY BULLETIN.

A bi-monthly Journal of Botany, devoted to the interests of teachers, students and amateurs. Especial attention is given to EDIBLE and POISONOUS MUSHROOMS and other CRYPTOGAMS. Prominent teachers of botany, specialists, and amateurs, from all parts of the country, are among its contributors. Subscription price only 50 cents per year. Write for special clubbing rates to members of Reading Circles, College Clubs and Mycological Societies. Address:

The Asa Gray Bulletin, Takoma Park, D. C.



**Acute and Chronic Rheumatism,
Neuralgia and Bout.**

Each Plaque Contains the Equivalent of:—Methyl Salicylate, gr. iv; Ext. Leopard's bone, gr. $\frac{1}{8}$; Ext. Rich weed, gr. $\frac{1}{2}$; Tinct. Trailing Sunnag, M. $\frac{1}{12}$; Ext. Felon wort, gr. j; Colchichin, gr. $\frac{1}{500}$; Powd. Garget, gr. $\frac{1}{2}$. They contain no opium nor other narcotic. Full particulars concerning administration with each package. Owing to the costliness of some of the ingredients of these Plaques, No Free Samples can be furnished. Send 25 cts. coin or stamps, for a liberal sample, or send a \$1.00 Bill for 100 Does to the

HOWARD PHARMACAL CO.

ST. LOUIS, MO.

THE AMERICAN

MONTHLY

MICROSCOPICAL JOURNAL.

Entered at the post-office as second-class matter.

VOL. XXII.

MARCH, 1901.

NO. 3.

CONTENTS.

The Beginnings of Things. Edwards	61-67
Peripheral Neuritis. Flemming	67-72
Is the Bacillus Always Present in Pulmonary Tuberculosis.	72-74
Do Bacilli Kill? Wyman.	74-76
Malaria. Lord Lister.....	76-79
MICROSCOPICAL APPARATUS.—Sterilization of Milk; The Milk Thermophore	79-80
MICROSCOPICAL MANIPULATION.—Canada Balsam and Pine Turpentine; Differential Stain for Bacilli; Micro-chemical Reagent for Tannin; Advantages and Limitations of Stirlizing Milk; Staining Fat; Preservation of Desmids	80-84
MICROSCOPICAL NOTES.—Pathogenic Bacteria; Diatoms; Bubonic Plague; Brownian Movement	84-85
BIOLOGICAL NOTES.—Multiplication of Bacteria.....	85-85
MICROSCOPICAL SOCIETIES.—Royal; Quekett	86-89
NEW PUBLICATIONS.—Botany; Objects for Microscopes.....	89-90

The Beginning of Things.

ARTHUR M. EDWARDS, M. D., F.L.S.

How things began at the first, of course we do not know, but how they begin now we can pretty thoroughly understand. And this can be told to us by those who use the microscope. I say use advisedly. For playing with it is not using it. To use it understandingly, we must work with it over and over again. We must have the most authentic and the best objectives that can be got. In fact we must be thoroughly *aufait* with its use in every branch of science. Then working with the microscope we find the following things.

We look at a mass of water, such as is recently distilled, and we see that it is transparent, that is to say we do not see anything in it more than we do when examining it not magnified, and seen with the unassisted eye. It

seems to be colorless, and we look through it and see objects on the other side. But after a time while we look longer and longer at the water it becomes milky, as we say. It becomes faintly, shadowy and slightly opaque. Now what is this change due to? It becomes nebulous in fact and this nebulosity must be due to some change in the composition of the water as we know.

It cannot be the same water that we have been looking at previously. It must be something else than water which has appeared, and this can be seen by placing a mass of water in a vessel at any time, but preferably in the spring and still more preferably when something has been dissolved in it. A solution of hay is commonly used, and has been used for a long time when what is called "spontaneous generation" is looked for.

Now using a magnifying power of at least twelve hundred diameters, 1-12th of an inch objective as it is commonly called, with a No. 3 or B ocular we have such a magnifying power, and we see that the nebulosity is caused by extremely fine organisms or seeming dots. They are in constant motion, not in one way, but trembling this way and that. They are what are called Monads. Monad is a term of D. F. Muller which Pritchard says in his History of Infusorial Animalcules, 1852, are so named from its having been supposed to be the limit of animal organization. First there appear masses of jelly-like extremely small amœbas. Let us see what Dr Leidy says about it for he gives the best account of amœba that I can find. He says "it is an animal" when at rest, a spherical or oval mass of soft, hyaline, colorless, homogeneous, pale, granular protoplasm, possessing extensile and contractile power, and in the active condition devoid of an investing membrane, or any kind of covering. This is all. It is in motion when we see it, but motionless when first found.

Let us imagine a drop of the white of an egg, any kind of egg, be it animal or vegetable or protiston. For that

is protoplasm and is also an amœba. I speak advisably. For it is an amœba, for chemically or otherwise it cannot be distinguished from a living thing which we call an amœba. We have then seen life beginning and begun a living thing, an amœba.

Now what is the origin of this living thing, this amœba, this mass of protoplasm? From what do they or it originate? From protoplasm as botanists call it, from sarcode as zoologists term it. This is the "physical basis of life" as Huxley termed it, the origin or beginning of force or energy, the "jelly specks" of the biologist. And going no further back than these "jelly specks" can we determine their beginning? I do not see how we can, and yet we can appreciate the origin of those "jelly specks." But we must determine and appreciate their origin materialistically also.

We cannot see how they originate from unseeable, unrecognizable matter. But we can see if we watch unseeables change to seeable matter. I do not know how it is possible, but it is possible, although our eyes are not strong enough to see it. We see what is before them and still is unseeable with any power of the highest magnifying lenses which we now have. For that cannot reveal even the ultimate molecules of the physicist, and the molecules are of course unseeable. Let us begin therefore where we can see.

As I have said, when we view the mass of water which contains protoplasm in it, or if we take the white of an egg and wait until it changes, which it does in time, it putrifies, we say. It then becomes alive, Bacteria or Monads appear in it, and this it does when it is covered up out of contact with the air. It so putrifies also. Bacteria appear also, and life is formed. We cannot know how it is but we see it. We see that our water is transparent. But while we are looking at it there appears a certain darkening as it may be called, or a shadowy appearance

where the water is becoming cloudy, and this is where the protoplasmic unit, as it has been called, appears.

Here the "jelly-specks" eventuate. It is hazy at first but at last there appears an amœba. This is the thing called *der kleine Proteus* by Rosel, in 1755, in his *Insecten Belustigung*. Dr. Leidy says that it is this thing which Rosel called an amœba in his *Recreation Among Insects*, published in Nuremberg. He accompanied his descriptions with nineteen well-executed and colored figures engraved by himself. In fact this is what the microscopist sees generally.

But I think he can see something which appears also still more generally. In short I have seen this thing for several years, about forty, everywhere where moisture, not water exclusively, is present. In the green scum that appears on trees, in or on clay, or on the soil that is in the fields or in gardens, and in fact everywhere, where organic and inorganic matter is and is moistened. I saw it over forty years ago and have waited to publish it until now. There is a granular matter, so to call it, much, smaller than the tiniest amœba that can be seen. It is called monad by Muller. We can see it when taking some clay and examining it under a microscope, by immersing it in water. A 1-12th of an inch, or a 1-16th of an inch objective if it is well made, will show it very well. A $\frac{1}{4}$ th of an inch has shown it but not well. It is not exactly round or spherical.

It is somewhat oblong, nearly like an egg, a chicken's egg, only it is the same shape at both ends, whilst the egg is longer at one side than the other. Then again it is not at rest. It is in motion, trembling on in its path. Not seeming to have any part formed for a head or other function, but trembling and seeming unstable in being. It has been instanced as an example of Brownian motion, and it is Brownian motion.

The mode of motion of the granule has not been, it

seems to me, thoroughly explained as yet. I explain it in this manner, and I will illustrate in this way. Let us drop a piece of sodium, (natrium the Germans call it, and we Latinize it by calling it natrium in chemistry and denote it by the symbol Na), into water and watch what takes place. We represent the water by the symbol H_2O . When the Na comes into contact with the H_2O , it immediately takes up the O and forms the compound Na O. At the same time it sets the two equivalents of hydrogen free. When O unites with Na, a chemical action is set up and heat is generated, heat enough to fuse the Na O, and when a substance is fused it becomes a liquid and when a liquid it assumes the form of a sphere which rests upon the plain surface of the H_2O . But H_2 , hydrogen, is a gas, the lightest substance known. It forms just at that point where the Na O, the sphere, rests upon the water, and tends to escape upwards, (for it cannot escape downwards) and pushes the globule of Na O to one side. As the globule of Na O has thus begun its travels it rushes to the opposite side until it rolls upwards on the surface of the plain of water until it meets the side of the containing vessel when it rolls down again.

Thus the motion has commenced. A motion which remember resides in, and is so to speak, a portion of a dead particle of matter. Now what does that motion consist of, and what is its cause? The chemical or physical action of the molecule of this fluid,—Na in this case, acting on the molecule of the fluid, H_2O in this case. And all motion is this chemical or physical action. I say all motion, be it in a molecule of the so-called dead matter, Na O, or a molecule of the so-called living matter, protoplasm, a monad or a man himself.

And in what can the so-called living matter be distinguished from the dead matter? Nothing but motion, and dead matter has that also. This monad has been bandied about between the animal kingdom, as usually rec-

ognized, and the vegetable kingdom by every observer. It seems they make some new discovery which entitles him to place it in one kingdom or the other,—sometimes as a whole organism, sometimes as a stage or a portion of an organism.

An amœba is found in the soil in the fall where malaria prevails in Newark, N. J., and most likely at other points. It is round or spherical and no nucleus or nucleolus is seen. It is stationary, not moving at all and may be kept two or three weeks and does not seem to change at all in all that time. It is like figure II, Plate V, in Leidy's *Fresh-water Rhizopods of North America*, 1879, under the name of *Amœba villosa*, but as shown by Leidy's figures from 1 to 19 it changes its relations and appearances to a vast extent. In short it makes various appearances and shows as amœba proteus, verrucosa and radiosa, in fact others also.

We cannot distinguish by appearances one of these amœbas from another, and they cause or do not cause different relations in various animals and vegetables when they come into contact with them.

When the chyle or lymph is examined, it is found to contain certain objects which are alike and, in fact, are, as far as we know, amœba. They have the appearance of amœba and these are also found in blood along with red blood corpuscles. They are known as "white" or "colorless corpuscles" or "leucocytes." They are mentioned as "amœboid in motion." In fact they are amœba and have all the qualities of an amœba, and take up food and other apparently unassimilable bodies like any other amœba. But the strangest thing about amœba, and this applies to the leucocytes likewise, is that they are present in large numbers when the individual suffers from what is called malarious fever. This is the parasite which has so world-wide a reputation as being the cause of or at least accompanied by malarial fever.

The classification of the parasite is of much uncertainty. Some observers place it in the animal kingdom and some in the vegetable kingdom, but none place it in the protista, so far as I know. Ranking it in the protista is provisional of course. It is a biological organism, having what is known as life and being moveable and going about its way reproducing and dying.

These organisms are omnipresent and omnipotent, but existing and reproducing and passing away as are all things and thus we see the beginning and the ending.

PERIFERAL NEURITIS.

ROBERT A. FLEMMING, M. D.

Proceedings of the Scottish Micro. Society, Vol. III.

These words used to denote a certain change of condition of the nerves, have recently been prominent in the papers in connection with the subject "arsenic in beer."

In a paper on ascending degeneration and the changes which occur in the central end of a divided nerve as the result of section or ligature, and I described the changes consequent thereon in the nerve-cells of the anterior cornua of the cord, and the cells in the ganglia in the posterior nerve-roots. Similar changes occur in these nerve-cells in peripheral neuritis, the cells show marked chromatolysis, peripheral displacement of the nucleus, and diminution in size of both cell and nucleus. Not infrequently the chromatic granules are gathered in a dense mass around the nucleus, while more rarely they become peripherally arranged.

But it is especially the changes in the nerves themselves which I wish to demonstrate. These changes consist in:—(1) Degeneration of nerve fibres, axis cylinders, and myelin sheaths. (2) Changes in the blood-vessels, especially the capillaries and arterioles of the nerve. (3) Exudations into the funiculi of the affected nerve.

(1) *Degeneration of nerve-fibers, axis cylinders, and myelin sheaths.*—The axis cylinders become vacuolated, soon break up, and, as described by Von Bunge and others, many fragments of axis cylinder may be seen enclosed in myelin balls inside the neurilemma sheath. The myelin breaks up into smaller and smaller balls and eventually disappears. These changes are better marked near the periphery of the affected nerves; but they do not gradually become more advanced the further the nerve is traced from its origin. Healthier portions of a nerve fiber may be seen between more degenerated parts, and careful study of many sections cut from a single nerve, such as the anterior tibial, demonstrates one remarkable point to which far too little attention has been directed, namely, that the segmental nuclei—i.e., the nuclei of the neurilemma sheath, have a very important trophic influence over the axis cylinder which it protects; it has been fairly definitely demonstrated that these segmental nuclei proliferate rapidly once the axis cylinder and myelin sheath have degenerated; but it is important to note that in these intervening more healthy parts of a nerve fibre, the integrity of the segmental nucleus and the integrity of the axis cylinder occur together.

It has even been suggested that the new axis cylinders may develop from segmental nuclei in the processes of regeneration of a nerve fibre. But, although this is contrary to my experience, and from an embryonic standpoint is most improbable, such statements show that to these segmental nuclei more important functions are described than formerly, and indirectly they strengthen the position which I take up.

The disintegration of the myelin sheaths requires no special description, as it is exactly similar to the degenerative changes which occur in a nerve fibre undergoing degeneration after section from its trophic cell.

I wish, however, to draw your attention to the fine med-

unmyelinated fibres which are contained in all sensory-motor nerves, and to the fact that they appear to degenerate specially early and completely in peripheral neuritis. These fine fibers are of extremely small size; they have a distinct, although comparatively slender, myelin sheath, and they generally occur in small groups throughout each funiculus. These fibers have often been mistaken for non-medullated nerve fibers when the myelin sheaths have not been taken on the staining reagent sufficiently deeply. In a paper published in the *Journal of Anatomy and Physiology*, I ventured to assert that these fibers were mainly vaso-motor in function, an opinion held also by Gaskell, and were more intimately associated with the changes in the blood-vessels, and the exudations which occur in peripheral neuritis. These fibers are especially well supported by connective tissue strands, and when they degenerate they are replaced by fairly dense fibrous tissue which marks their former site. This I can show you from sections taken from the central end of a rabbit's sciatic nerve, some six weeks after division or ligature, special care having been taken to prevent reunion occurring.

Just above the section or ligature, the sites of these fine fibres are marked by small dense areas of connective tissue. This is due, I believe, to the rapid degeneration of these nerve fibers when their function is interfered with, the vessels which they supply being in the peripheral part of the limb. A little higher up these small strands of fibrous tissue still contain a few healthy minute nerve fibers, and the number increases as the nerve is followed upwards to the cord.

The association between these fibers and the vessels can be traced in the following way:—The fibrous tissue replacing the fine fibers contracts, and where most of the fine fibers have lost their function—near the divided end of the nerve—any fine fibers in the immediate neighborhood, whose function is still intact, cannot escape pres-

sure. The vessels in the lower part of the central cord of a divided nerve show the nuclear proliferation, and, to a certain extent, the perivascular exudation to which I refer later.

These changes become less marked as the nerve is followed upwards towards the cord, and therefore it seems probable that the effect of pressure on these fine fibers is to produce changes in the vessels which are very similar to those met with in peripheral neuritis.

It should be added that unquestionably these fine fibers, if vaso-motor as I contend, supply vessels in muscles and other tissues as well as in the nerves themselves, and similar changes may be seen in the walls of the vessels supplying the muscles, etc., as in the vessels of the nerves.

In peripheral neuritis, the first fibers to suffer degenerative changes are these fine fibers, and where they suffer, exudations and vascular changes follow. There is hardly any question, in modern neurological opinion, that the toxin in alcoholic neuritis affects the cell, the centre of the neuron first, and probably chiefly, while the nerve fiber is secondarily affected. We know that the cells in the anterior cornua of the cord, the cells in the posterior nerve root ganglia, and even the cells in the brain undergo distinctive changes which are often selective as regards group or groups of cells affected in different cases.

It is much more difficult to describe the changes which always certainly occur in the vaso-motor cell centres. My efforts to elucidate these changes have so far been very contradictory. It seems not improbable that the toxin has selective action on parts of vaso-motor neurons; and as I hope to be able to show, the pathological changes in peripheral neuritis strongly support this opinion.

When the affected nerves from a case of peripheral neuritis are examined, the small fibres are seen to be specially degenerated, and, in common with the other nerve

fibres, more and less affected parts of the nerve occur irregularly, often a less affected part being peripherally situated to a part much more markedly degenerated. This fact has been stated by many observers, and examination of nerves by serial or nearly serial sections demonstrates the truth of this statement.

The explanation may, I think, be sought in the second and third divisions of this paper to which I now refer briefly.

(2) *The Changes in the Blood-vessels.*—These are: proliferation with enlargement of nuclei of the endothelial cells of the intima, as also nuclear proliferation in the media and adventitia in the smaller arteries and capillaries, and to a much less extent in the smaller veins.

The nuclei of the intima almost block the lumen of the smaller capillaries and all the smaller vessels in the nerve, and those in the muscles are similarly affected. These changes are well marked in peripheral neuritis, and are also found near the end of the central portion of a divided nerve, but are not nearly so definite in the peripheral end of a divided nerve.

(3) *Exudations into the Funiculi, &c.*—These are typical of toxic neuritis. They are well seen round the vessels, and especially those showing the nuclear changes. These exudations may also be seen round the blood-vessels of the peri- and epi-neurium and also the muscles.

The nature of the exudation varies:—It is generally apparently lymph with a varying number of leucocytes and lymphoid cells and sometimes red blood-corpuscles.

The amount of the exudation varies greatly in different cases, and when they have been in existence for some time, young connective tissue cells may be seen replacing the exudation, and of necessity resulting in incomplete recovery of function of the nerves so affected. Exudations almost certainly point to an inflammatory process as distinct from simple degeneration. They are absent in the

peripheral end of divided nerves, but a limited amount of exudation is seen in the central end of a divided nerve.

I believe the exudations in peripheral neuritis are due to the local action of the toxin either in lymphatics or blood-vessels or both, and the varying amount of exudation at different levels in an affected nerve may depend on the fact that the blood supply to the funiculi enters by small branches of arteries, which run for a long course down the funiculi; and probably, where the branch enters the funiculus there the exudation is most marked. My serial sections so far bear out this theory, although it is difficult to prove that it is absolutely correct.

Of more practical importance is the *role* played by the exudation in causing the pain, interference with function of nerve fibres, and when not removed, the permanent disablement of the nerve.

The affection of the fine fibers, the nuclear proliferation in the small arteries and in the capillaries, and the exudations are apparently all closely related together, and I have endeavored to demonstrate how far the connecting links in my chain of evidence cover existing facts, although I admit much has yet to be discovered before the theories can be considered indisputable.—*English Mechanic*.

Is the Bacillus Always Present in Pulmonary Tuberculosis?

HUBBARD WINSLOW MITCHELL, M. D.

The presence of the tubercle bacillus is generally regarded as an infallible sign that the disease is true tuberculosis, and I have myself hitherto regarded this sign as infallible, but in many cases which have come under my care where the symptoms were of unusual severity, such as coarse bubbling rales, more or less extensive in one or both lungs, extreme emaciation, night-sweats, diarrhœa, loss of appetite, thirst and fever, with copious expectorations of offensive sputum, no bacilli existed. Some of these cases recovered, while others died.

The microscopist who examined the sputum several times in each of these cases pronounced them not tuberculous because he found no bacilli, yet the symptoms differed in no single respect from the cases where bacilli did exist, and were associated with a similar train of symptoms. If these were not tuberculosis, they certainly were not to be distinguished from it, and I treated them in the same way as I treated the cases where bacilli were persistently found.

If the presence of the bacillus is the absolute and unvarying sign that the disease is tuberculosis, and that cases without the bacillus are not, then our task is easy. But what shall we say when two cases present themselves, each having all the severe and distressing symptoms that accompany pulmonary tuberculosis, and in one case there are bacilli, and in the other there are none, yet each running a course identical in all respects. I have seen numerous cases where no bacilli were found at any time during the course of the disease, yet they were just as severe, and quite as fatal as cases where bacilli were persistently found.

The number of bacilli in a case, whether few or numerous, seems to have no special influence upon the severity or duration of the case. Cases where few or many bacilli, or no bacilli at all were found, were not to be distinguished from each other. If then, cases are identical where bacilli do exist, with those where they do not exist, then we must look a little further before we say positively that pulmonary tuberculosis depends for its being upon this special germ.

In all cases however, the pus-cell is present. Whether or not we find the bacillus, the pus-cell is never absent. The ulcerative nature of the disease would tell us this. Now this ulcerative condition of the lung we call tuberculosis, seems capable of generating a certain toxic principle, which poison enters the lung of some other indi-

vidual and sets up a like process there. It seems not unlikely that the pus-cell may be freighted with this special subtile poison, and when voided in the form of sputum and dried, it may commingle with the surrounding dust and find its way to a healthy lung and set up its baleful influence. We are taught that the disease is disseminated solely by the bacillus, but in view of the above facts, it would be well to watch and study the influence of the always present pus-cell.

In beginning treatment in a case where a reasonable hope appears for a final cure, the first thing in my judgment to do is to improve the physical condition of the patient by the use of nutritious diet, by rest, the free use of the bath, by quinine and strychnine to reduce fever, by the judicious use of stimulants such as whiskey or brandy, to fill the depleted blood vessels by the copious use of some good mineral water, and lastly and above all, the persistent use of some remedy which is calculated to saturate the blood and so bring it in contact, as far as possible, with the diseased portion of the lung.

In my hands the use of the solution of hypochlorite of sodium to which is added hydrochloric acid and bromine has proved the most efficient.

I usually give the remedy in half ounce doses before each meal, and at bed time, and sometimes I have increased it up to 3 and 4 per day, but rarely above 3. It must be persevered in for a long time as the disease is very chronic in its course, and with the adjuncts above named, with complete rest I have had results which greatly encouraged me.—*Medico-Legal*.

Do Bacilli Kill?

SURGEON GENERAL WALTER WYMAN.

Many people live a long and active life with tubercle bacilli encysted in the apex of one lung. As long as they have plenty of fresh air and sunshine, and good sanitary

surroundings, they remain well. But give such a person poor food or bad sanitary surroundings and see what happens. The battle going on between the bacilli and the cells results in a victory for the bacilli. The cells die and the victorious bacilli spread havoc through the lungs. We, therefore, have a scientific proof of the sense of the old-time notions of the old-fashioned doctors, who taught the value of fresh air and sunshine, of good food and exercise, of cleanliness and dry dwellings, and we find that the conditions of health which result from such good sanitary conditions are, after all, among the very best preventives against infection.

That good sanitary environment, enhancing the general health, is the best means of eliminating contagious disease, is illustrated by a conversation which I have had within a week with the Director of the Hygienic Laboratory of the Marine Hospital Service, Dr. Rosenau, who has just returned, after a prolonged period of study and investigation in the Pasteur Institute in Paris. Upon inquiring as to the latest phases of scientific investigation and the trend of thought at this great intellectual centre, among other matters, he stated that there seems to have arrived a period of pause in bacteriology, or at least a spirit of inquiry as to the true relation of microbes to the diseases of which they have been considered the special agents. Dr. Rosenau's statement is as follows:

"We have lately been compelled to modify some of our notions of the causes of contagious and infectious diseases. After the brilliant discoveries by Pasteur and Koch, it was thought that the presence of the pathogenic microbe organism was like the bite of a venomous snake, surely poisonous. But now we know that there are other conditions beside the presence of the microbe necessary to produce disease. Many people go about with virulent cholera vibrio in their intestinal canal, yet they are not sick, have pneumonia, Why? Because their cells are

vigorous enough to prevent the diplococci invading the lungs, but put such a person under bad sanitary conditions, or depress his vitality, and the microbes are not phagocyted—they invade the lungs and pneumonia and death follow.”—*Address at Havana, Feb. 7, 1901.*

Malaria.



LORD LISTER.

Before the Royal Society.

The subject has now reached a stage at which it may be not unfitting to refer briefly to what has been accomplished. The term “malaria” implied the belief that some vitiated state of the atmosphere was the cause of the disease. But the knowledge gained of late years of the parasitic nature of infective disorders pointed clearly to such an origin of the intermittent fevers, as the various manifestations of malaria have been termed. Accordingly diligent and long-continued search was made in the water and the soil of malarious districts in Italy for the suspected living agent, but without success. The discovery was made in 1880 by Laveran, a French army surgeon stationed in Algiers, who observed in the red blood corpuscles of malarious patients what he regarded as adventitious living organisms; not of vegetable nature like the bacteria which constitute the *materies morbi* of so many infective diseases, but a very low form of animal life. In what he believed to be the youngest condition of the organisms, they appeared in the red blood-discs as tiny specks of colorless protoplasms, possessing amoeboid movements. These growing at the expense of the red corpuscles which they inhabited, consumed them more or less completely, at the same time depositing in their own substance a peculiar form of dark brown or black pigment, such as had long been known to form characteristic deposits in the organs of malarious subjects. As they grew they assumed various forms, among which was what Laveran termed

the "rosace," a rounded body bearing at its circumference little spherules, while the pigment was accumulated at the centre. This discovery of Laveran's, at first regarded with the gravest suspicion by pathologists, was the first great step in the etiology of malaria. It supplied the means of distinguishing the disease from its counterfeits, and it explained the wonderful specific efficacy of quinine, till then given only empirically. Quinine is remarkable in the circumstance that it acts with deadly effect upon some microbes, in dilutions which are quite un-irritating to the human tissues. It can thus be given in sufficient doses to kill the malaria parasite in the blood without injuring the patient. Nine years after Laveran's discovery, Golgi, of Pavia, who had been specially studying the "rosace" form of the parasite, and who had become convinced that the spherules at the circumference of the rosace were sporules of the microbe, announced that he had observed differences between the rosaces of tertian and quartian forms of fever, so great and so constant as to make him satisfied that they were two distinct species of organism. At the same time, he had made the extremely important observation that the periods of occurrence of the fever corresponded with the times of maturation of the rosaces. These all coming to maturity about the same time, shed their sporules into the blood, and this determined the febrile attack. The free sporules, then, according to his view, attached themselves severally to other red discs constituting Laveran's tiny amoebæ, and grew in the red corpuscles without causing symptoms till they had produced a fresh crop of sporules ripe for extrusion; the time for this being two days in the tertian and three days in the quartian form. Thus the periodicity of the intermittent fevers and their variety in that respect were alike explained. A few months later a third species of the parasite was recognized, having the peculiarity that some of its individuals, instead of being of rounded form

were of crescentric shape. These species received the title æstivo-autumnal, on account of the season in which it showed itself in Italy. It was not so regular in its periods as the others, and was much more dangerous. The existence of these different species was at first very generally doubted, but it is now universally accepted, and is of very great importance. The examination of a drop of blood from the finger of the patient enables the physician to decide not only whether the disease is malaria, but which of the three types it will follow. The more dangerous crescent form is commonest in the Tropics, and hence has been termed by Koch tropical malaria. The quartian has proved the mildest of the three. The process of sporulation might seem at first sight to explain the whole life-history of the parasites. For their propagation within the human body that process does indeed make ample provision. But the mystery remained—how did they gain entrance into the human system? Though present in abundance in the blood of the malarial patient, they are absent from the excreta. Spontaneous generation having been long since exploded, what could be their mode of origin in the external world? This problem has of late been completely solved. Among the forms of the parasite observed by Laveran was one which he termed “flagellated,” possessing filamentous appendages which exhibit extremely active movements, by virtue of which they were often seen to break off from the parent microbe and swim away. These flagella were regarded by many biologists as products of degeneration resulting from the abnormal influences to which the parasites were exposed in blood outside the body. This Laveran could not believe; indeed, it was the remarkable activity of the flagella that finally satisfied his own mind that what he had discovered were really living parasites; he regarded the flagella as the highest form of development of the microbe. There was another observer who felt equally con-



vinced that the flagella were living elements—our Fellow, Dr. Manson. He, however, went a step further. Seeing that the flagella were never met with in blood when first drawn, but only made their appearance after some little time had elapsed, he conceived that their function must be that of spores for spreading the parasite in the external world, and some suctorial insect seemed to him the probable agency for their diffusion. He had observed several years ago that another parasite of the human blood, a microscopic nematode worm, *Filaria*, is drawn with the blood into the stomach of a kind of mosquito, and finds in the insect a secondary host, in the tissues of which it passes through a new cycle of development. He became deeply impressed with the idea that a similar series of events might occur with malaria, and he expounded his views fully before the College of Physicians. The notion that mosquitoes might be in some way associated with malaria had occurred to Laveran and to others, but by no one had it been brought home with such logical force as by Manson.

MICROSCOPICAL APPARATUS.

APPARATUS FOR THOROUGH STERILIZATION OF MILK. I. JUNDALL.—That tubercle bacilli are not killed by the usual methods of sterilizing milk in creameries has been demonstrated by the discovery of living bacilli in market butter made according to the most approved modern methods. Jundall ascribes this failure in thorough sterilization to the fact that the bacilli are not exposed long enough to the high temperature required to destroy them all. He has invented a contrivance to supplement the ordinary apparatus, which, by retarding the circulation of the milk through it, enables the action of the heat to be prolonged and accomplishes the desired end without injury to the milk. It consists of a cylinder fitted with a number of

alternating horizontal discs nearly filling the lumen. The milk thus follows a zigzag course through it. Tests with animals inoculated with milk infected with enormous quantities of bacilli and then sterilized in this manner, showed that not one of the bacilli had remained alive. Jun-dell uses it with the "G. Salenius radiator," which enables the butter to be made at once from the cream without further delay or manipulation.—*Nordiskt Mediciniskt Arkiv* (Stockholm), August 9.

USE OF THE MILK THERMOPHORE.—Dr. Paul Sommerfeld says that milk kept in a thermophore for five hours is as free from bacteria as sterilized milk. Tubercle and typhoid bacilli are rendered innocuous by this time. Previously sterilized milk placed in the thermophore is rendered absolutely free from germs in five hours.—*Berliner Klinische Wochenschrift*, Oct. 1, 1900.

MICROSCOPICAL MANIPULATION.

CANADA BALSAM AND PINE TURPENTINE COMPARED.—From an investigation carried out by Tischtschenko (*Chem. Zeit.*) it seems that the turpentines of the fir and of the pine are very nearly identical in composition and properties—that the products of both substances have identical proprieties and qualities, and that the resins are in all respects the same, even to the indices of polarization. The investigator, therefore, concludes that pine resin may be substituted for Canada balsam in all cases.

This statement may be, and probably is, true of the turpentines of European pines (*Pinus larica*, *P. silvestris*, *P. pinaster*, etc.) but we scarcely believe it to be true of the produce of the Southern long-leaved pine (*Pinus australis*). At any rate, some mounts made with virgin turpentine of the long-leaved pine, treated in all respects as the Canada balsam in preparing it for a microscopical mounting medium, soon spoiled, becoming granular and opaque. It

is possible, however, that the failure was due to errors in manipulation. We hope that some of our Southern readers, interested in microscopy, will experiment in this direction and let us hear from them on the subject.

A DIFFERENTIAL STAIN FOR BACILLI.—M. Gautrelet, searching for some method to stain the bacilli of tubercle so that the living microbes could be distinguished from the dead, and noting that in the urine of those suffering with hectic fever (tuberculous) the bacilli were so strongly colored by some urinary pigment that they could easily be seen and recognized, concluded that the coloration was due to urobilin. He thereupon experimented with the agent, and succeeded in staining the bacilli of sputum with it without the application of heat. He used the following formula:

Urobilin.....	1 part.
Glycerin.....	20 parts.
Distilled water.....	20 parts.
Alcohol.....	30 parts.

To use: Spread the sputum on a cover-glass in the usual way, and place the latter, without drying or passing through the flame, directly into the solution. At the end of an hour it may be removed, the superfluous liquid taken up by means of bibulous paper, and the clean side of the cover-glass wiped dry. The object is now ready for examination. The living bacilli will be found stained a yellowish brown, and may be seen to continue their oscillatory movements. By means of examinations made by the aid of this process, M. Gautrelet was able to demonstrate that hydro-fluoric acid is a powerful anti-bacillary, capable of sterilizing tubercular cultures.—*National Druggist*.

MICROCHEMICAL REAGENT FOR TANNIN.—Lantz (*Pharmaceutische Rundschau*) states that ammonical copper sulphate is an excellent microchemical reagent for tannin. It is, he declares, far more delicate than any reagent hith-

erto proposed in this direction. In investigating plant-tissues for tannin, the substance is put in a test tube or watch glass and the reagent poured over it until it is completely covered, and in this condition it is set aside for from 3 to 4 hours. At the end of this time the reagent is poured off and the material is thoroughly washed with water. It can now be placed under the microscope, and the cells containing tannin will be found to be stained from brown to black, according to the amount of tannin present. The reagent is prepared as follows: Dissolve 2 gms. copper sulphate in distilled water, and add ammonia water until the precipitate at first formed is again taken up. Distilled water is then added until the solution measures 100 ccm.—*National Druggist*.

ADVANTAGES AND LIMITATIONS OF STERILIZING AND PASTEURIZING MILK.—Dr. A. D. Blackader of Montreal. Milk obtained under unfavorable conditions and kept at a rather high temperature contained many bacteria, and in addition their spores and toxins. According to our present knowledge, all forms of bacteria are undesirable in an infant's food. It had been shown that 99.8 per cent of the bacteria could be destroyed by pasteurization. The older the milk was the more difficult it was to pasteurize it. Pasteurization at 70° C. destroyed the vast majority of the forms liable to produce extensive and rapid change in the quality of the milk. It was necessary in most instances to maintain the pasteurized milk at a low temperature in order to preserve it from further change. However, the same could be said of milk heated to 100° C. Milk exposed to 60° C. or 140° F. had ninety-six to ninety-nine per cent of its bacteria destroyed. Russell had found that when milk was heated in tubes to 140° F. tubercle bacilli were not entirely killed because the little pellicle which formed on the surface of the milk protected the bacilli to some extent. If this pellicle was broken

up, complete destruction of the tubercle bacilli was assured. Milk raised to 100° C. was markedly altered in taste, smell, and chemical composition. The albumin and globulin were coagulated, the lecithin and nuclein were destroyed, and the organic phosphates converted to some extent into the inorganic phosphates. For the coagulation of milk in the stomach calcium must be present in a more or less free form. It was probable that the preliminary curdling of milk was an aid to digestion. It was also probable that in milk heated in this way certain useful ferments were destroyed. As long as milk could be rendered practically sterile at comparatively low temperatures it seemed useless and even deleterious to subject the milk to a higher temperature. It was generally stated that milk was pasteurized at 157° F.—Meeting N. Y. Academy of Medicine.

CONCERNING THE METHODS OF STAINING FAT.—By Dr. J. B. Levinson.—This author found that in staining nerve fibres by Wolter's method, droplets of fat resisted the action of decolorizing agents, and assumed a deep blue color. This, with the fact that osmic acid and Sudan III are not satisfactory methods of staining fat, induced him to study Wolter's stain with reference to its action on adipose tissue and fat droplets. After a series of experiments, he found that the following method gives a satisfactory stain for fat: (1) Fixation in Muller's fluid for from two to five weeks, depending upon the size of the specimen. Dehydration in alcohol, beginning with seventy per cent. Imbedding in celloidin. (2) Sections about 10 to 15 micron in thickness are transferred directly from alcohol into dye, where they remain for twelve hours at the 40° C. The staining solution used is the same as that recommended by Wolter, namely, a twenty-seven-per-cent solution of hematoxylin, according to Koulitchitz (2 grammes of hematoxylin are dissolved in a little absolute

alcohol and mixed with 100 c.c. of two-per-cent acetic acid.) At first this dye is yellow in color, but if allowed to stand it will turn red, and its staining power will increase. (3) Washing in water. (4) One-per-cent aqueous solution of potassium permanganate, for from ten to fifteen minutes. (5) Washing in water. (6) Two-per-cent solution of oxalic acid. The drops of fat stain a grayish violet, the surrounding portions of tissue being completely decolorized. If this is not the case, the decolorization may be repeated after a trial section has been examined under the microscope. If it is desired to counter-stain the tissues, strong solutions of carmin for twenty-four hours will give good results.—*Vratch*, Sept. 23, 1900.

THE PRESERVATION OF DESMIDS.—The late Mr. W. H. Walmsley's plan was as follows: Having been perfectly successful in preserving the color in many of our fresh-water algæ, it may be that the same method would prove successful with desmids. My plan is simply to have a wide-mouthed bottle, with glass stopper, filled with distilled water, in which I have a number of pieces of camphor. When it is desired to mount the algæ, I place a portion of the same in some of this camphorated water to which a few drops of glycerin have been added, in a watch-glass. At first it will become lemon yellow, but after a few hours the original green returns in its full vividness, then I mount in a shallow cell with a portion of fluid.

MICROSCOPICAL NOTES.

Pathogenic Bacteria. An extended reprint of Dr. Dobson's article on Bacteriology in our January number is to be found in the *English Mechanic and World of Science*, of April 12. The article was a review of McFarland's *Pathogenic Bacteria*. The publishers W. B. Saunders & Co., have a London branch at 161 Strand W. C. where the work can be purchased.

DIATOMS.—Maurice Peragallo of Clermont near Paris, is issuing a "General Catalogue of Diatoms," printed by a sort of hectograph process in 16-page installments. Price 25 cents each. Up to March 1st, 30 installments had appeared and included the genera from A to K inclusive. It is in the French language.

BUBONIC PLAGUE.—The plague is now present in this country, in California. Had the State Board of Health of California had five thousand dollars at the beginning of the outbreak, probably it might then have stamped the fearful disease out of California; but the means and public support were not provided, and the disease has continued; now the legislature has appropriated one hundred thousand dollars with which the State Board of Health is to try to restrict the plague.

BROWNIAN MOVEMENT.—In his article upon "The Beginnings of Things," Dr. Edwards has given us a new philosophy of this movement. We call attention thereto so that no one will overlook it. He shows, likewise, that there is no such thing as dead matter.

BIOLOGICAL NOTES.

THE MULTIPLICATION OF BACTERIA.—A single bacterium has been calculated by Th. Nageli to weigh one ten thousand millionth of a milligram. The length of a generation is from fifteen to forty minutes. Supposing all the conditions for multiplication to be favorable the results are appalling. Cohn has estimated that a single germ can produce, by simple fission, two of its kind in an hour; in the second hour these would have multiplied to four; and in three days they would form a mass of four thousand seven hundred and seventy-two billions, an enormous mass, whose weight would amount to seventy-five hundred tons. Fortunately, these ideal conditions never exist, each germ requires food, and as the supply is always limited (not to speak of other items), great numbers starve.

MICROSCOPICAL SOCIETIES.

Royal Microscopical Society.—At a meeting on Oct. 17, the President, referring to the donation of Prof. Percival's work, "Agricultural Botany," said he could speak to the book being original both as to text and drawings, which was noteworthy in these days. It was an extremely valuable contribution to the subject of agricultural botany. Dr. Hebb brought before the notice of the meeting samples of stains for microscopical specimens prepared by Messrs Burroughs, Wellcome, and Co. The stains were in solid form, each "soloid," as they are termed, containing a definite amount of the reagent. The advantages of this form of preparation are simplicity and economy.

Messrs R. and J. Beck exhibited a new pattern student's microscope. It was of the continental form, and was chiefly noticeable for its cheapness, which was attained without sacrifice of quality by adopting an improved method of manufacture. It was called the "London" microscope, and had rack-and-pinion coarse adjustment, perfect micrometer-screw fine adjustment, vulcanite top stage iris diaphragm in sliding tube, and spiral substage fitting. Mr. F. W. Watson Baker gave an exhibition of slides and models illustrating the structure and development of the skin. Mr. Vezey said the society was greatly indebted to Mr. Watson Baker for giving this very excellent exhibition at comparatively short notice. Mr. Karop said he had only been able to glance at a few of the specimens exhibited, and he regretted there was no one present to discuss the subject, because several new points had recently been recognized by histologists in the structure of the skin, and it was rather a pity that the opportunity should be lost of having these demonstrated by someone who had made a study of this important and complicated tissue system. Mr. Vezey reported the death of a very well-known Fellow, Mr. Richard Smith, since the last meeting. He had devoted his attention to a study of diatoms, and was continually devising new contrivances. He had also done some good work in photomicrography. He had likewise made useful researches

in the germination of wheat, and had made a large number of observations and experiments in connection with this subject, and published a book upon it. He would probably be best known to some as the inventor and patentee of Hovis flour.

QUEKETT MICROSCOPICAL CLUB.—The 381st meeting was held on Friday, November, 16. A paper on the "Resolution of *Amphipleura Pellucida* with Dry Lenses," by Mr. A. A. E. Merlin, was read, in the author's absence, by Dr. E. J. Spitta. Mr. Merlin claimed to have resolved this diatom, mounted in various media, with a Zeiss 4mm. apochromat, N.A. .95, combined with eyepiece x 27, and a large axial cone; illuminant a $\frac{1}{2}$ in. wick paraffin lamp and copper acetate light filter. Dr. Spitta gave an exposition of Abbe's theory, and from it concluded that either the *Amphipleura* used was a coarse-lined one, or that Mr. Merlin possessed a phenomenally good or "photographic" eye. Mr. Nelson said that his own sight, which was formerly very good, was now insufficient to grasp very minute intervals of separation, and, using the same optical means as Mr. Merlin, he had roughly attempted the observations given in the paper, but found it impossible with a $\frac{1}{2}$ in. paraffin flame. He thought, however, that with a heliostat it could be done, and he hoped to experiment later on. He knew that Mr. Merlin had extremely keen vision. Mr. J. M. Offord said he could corroborate this; at the telescope he found Mr. Merlin could see details at once, which he himself could only discover by continued observation. Mr. Rousselet read a paper on *Asplachna intermedia*, and showed by description and drawings of the mastax, how it differed from *Asph. brightwelli*, with which it was generally confounded. Mr. Western quite agreed with Mr. Rousselet's conclusions, and considered he had given a very valuable study of this and the allied forms.

ROYAL MICROSCOPICAL SOCIETY.—Dec. 21, 1900, Mr. C. T.

Hudson was submitted for election as an Honorary Fellow. A valuable microscope, by Powell and Lealand, with a complete set of objectives and apparatus, received from Miss Whittall, whose late father desired that it should be given to the Society, was placed upon the table for inspection. Mr. E. H. Nelson exhibited a small pocket microscope, lent for exhibition by Mr. H. E. Freeman. It was made by H. Gilbertson, of London, but the date was unknown. It is non-achromatic, and designed for field use; it has neither stand nor stage; but in place of the latter it has a compressorium or live-box, which slides over the body of the microscope, this sliding tube constituting its sole focussing arrangement. Dr. Webb read the list of those who had been nominated by the council for election at the annual meeting in January as officers and council for the ensuing year as follows:—as President, Mr. Wm. Carruthers; as vice-presidents, Dr. Draithwaite, Messrs. Michell, Nelson, and the Right Hon. Sir Ford North; as treasurer, Mr. J. J. Vezey; as secretaries, Mr. Dallinger and Dr. Webb; as council, Messrs. Allen, Beck, Bennett, Browne, Rev. E. Carr, Messrs. Dodswell, Disney, Karop, Plimmer, Powell, Professor Urban Pritchard, and Mr. Rousselet; as curator, Mr. Rousselet. Mr. Barton exhibited some new forms of lanterns, which could be used for ordinary projection purposes, either with or without the microscope. The first was a lantern constructed so as to exclude all light from the room, except what passed through the lenses; the manner of using this in connection with a microscope was shown. One lantern exhibited was larger and more complete, and could be used for all purposes, including enlargements. The excellent definition of this lantern was demonstrated by the exhibition on the screen of photo-micrographs of mounted preparations of insects and of parts of insects mounted in balsam. Mr. Barton also exhibited and described several new forms of microscope, with attachable circular stage,

etc., and a new form of electric arc lamp for lantern use. A new form of lime-light was also exhibited, which attracted much notice from its extreme brilliancy, and the great steadiness and silence with which it burned. Mr. Nelson said he was very much struck with the perfection to which the last-mentioned lamp had been brought, and inquired if the gases had been enriched in any way, and how the light was produced with such a complete absence of noise. Mr. Barton said nothing was used but the two gases, and the effect was produced by causing them to impinge upon each other previous to their entrance to the mixing-chamber, and by the construction of the chamber itself.

NEW PUBLICATIONS.

Botany, an Elementary Text Book for Schools. By L. H. Bailey. New York. The McMillan Company. vii 355. 500 f. Prof. Bailey's large experience as a maker of good text books is well known. Not only is the subject of botany treated in a clear and lucid style, but the subject matter is well arranged as a whole. In this book Professor Bailey starts out with the idea that in secondary schools botany should be taught for the purpose of bringing the pupil closer to the things with which he lives. The study of botany should begin with familiar plant forms and phenomena. Schools and Colleges should seek to inculcate a love of plants. The mere learning of names of plants should not be the ultimate end of teaching botany any more than to study one phase of morphology, but rather botany should aim to teach the plant as a whole and as a living organism. Professor Bailey has attempted to do this, and in the reviewer's opinion has succeeded admirably. Take chapter VII where the subject of buds is treated. Here we have a short definition, and a few types are given. The dormant winter bud to the flower in its succes-

sive stages are described and figured. Professor Bailey is particularly happy in his choice of subjects as well as the illustrations accompanying this as well as many other chapters in the book. Take the subject of plants in sunlight, the illustration of the fern with sufficient and insufficient light, and the branches of cedar reaching for the light, the day and night positions of the clover leaf. Take the chapter on the dispersal of seeds. Not only does the author give an excellent series of illustrations as in figures 276, 280 and 281, but the important points in the chapter are emphasized by using different type. It is certainly an excellent idea to emphasize the important points. The less important matters are easily separated from the more important. Ecology as a special topic does not receive as much attention in one place as in some other recent text books since the subject is more or less brought into prominence in nearly every chapter in part I, so there is no need of bringing the matter together in one place. The average high school is not sufficiently well equipped to take up the subject of histology, but the discussion here is ample for most schools. Part IV is devoted to systematic botany. Part II the plant in its environment should have preceded the studies in cryptogams. The subject of Cryptogams perhaps could more logically have been placed in part IV. The text is not only a credit to the author but to the publishers as well. No pains have been spared by the publishers to make it an attractive book in every way.—L. H. PAMMEL.

1,000 *Objects for the Microscope*, M. C. Cooke, LL. D. The new Edition contains 500 illustrations and much valuable matter. Price, \$1.00.

Naturalist's Monthly Review is published by J. & W. Davis, Hythe st., Dartford, Kent, England. No 1 contains matters relative to insects, especially the Lepidoptera.

INVOLUNTARY SEMINAL EMISSIONS
can be **POSITIVELY, SPEEDILY** and **PERMANENTLY**
Corrected by the use of
EMISSINE

Put up in Gelatine-coated pill form. Dose ;— One, three times per day. Sample cartoon, containing 20 pills, with formula, will be sent to physicians on receipt of 50 cents.

St. Louis Pharmaceutical Co.,
St. Louis, Mo.

100 per ct. Profit. No Grain, Stock or Turf Speculation. Full particulars and more sample copies of choice magazines than you could buy for several dollars mailed for 10 cents. West. Per. Sub. Agency, 516 E. F. 2nd Ave., Milwaukee, Wis.



CARL REICHERT
MICROSCOPES.

SOLE AGENTS FOR UNITED STATES.

RICHARDS & CO., LTD.,

NEW YORK,

CHICAGO,

30 East 18 Street.

108 Lake Street.

THE ASA GRAY BULLETIN.

A bi-monthly Journal of Botany, devoted to the interests of teachers, students and amateurs. Especial attention is given to EDIBLE and POISONOUS MUSHROOMS and other CRYPTOGAMS. Prominent teachers of botany, specialists, and amateurs, from all parts of the country, are among its contributors. Subscription price only 50 cents per year. Write for special clubbing rates to members of Reading Circles, College Clubs and Mycological Societies. Address:

The Asa Gray Bulletin, Takoma Park, D. C.



**Acute and Chronic Rheumatism,
Neuralgia and Gout.**

Each Plaque Contains the Equivalent of:—Methyl Salicylate, gr. iv; Ext. Leopard's bane, gr. $\frac{1}{16}$; Ext. Rich weed, gr. $\frac{1}{8}$; Tinct. Trailing Sunac, M. $\frac{1}{12}$; Ext. Felon wort, gr. j; Colchicin, gr. $\frac{1}{600}$; Powd. Garget, gr. $\frac{1}{2}$. They contain no opium nor other narcotic. Full particulars concerning administration with each package. Owing to the costliness of some of the ingredients of these Plaques, No Free Samples can be furnished. Send 25 cts. coin or stamps, for a liberal sample, or send a \$1.00 Bill for 100 Doses to the

HOWARD PHARMACAL CO.

ST. LOUIS, MO.

INVOLUNTARY SEMINAL EMISSIONS

can be POSITIVELY, SPEEDILY and PERMANENTLY

Corrected by the use of

EMISSINE

Put up in Gelatine-coated pill form. Dose ;— One, three times per day. Sample cartoon, containing 20 pills, with formula, will be sent to physicians on receipt of 50 cents.

St. Louis Pharmaceutical Co.,
St. Louis, Mo.

100 per ct. Profit. No Grain, Stock or Turf Speculation. Full particulars and more sample copies of choice magazines than you could buy for several dollars mailed for 10 cents. West. Per. Sub. Agency, 516 E. F. 2nd Ave., Milwaukee, Wis.



CARL REICHERT

MICROSCOPES.

SOLE AGENTS FOR UNITED STATES.

RICHARDS & CO., LTD.,

NEW YORK,

CHICAGO,

30 East 18 Street.

108 Lake Street.

ified optical arrangement through having remarked the great strength of the resolution yielded by some realgar-mounted specimens under the Zeiss 3 mm. of N.A. 1.4 and a solid axial cone of about N.A. 1.2 from an oil-immersion condenser. I must confess that the exact theoretical resolving limit of an object glass of N.A. .95, as given in the table on page 85 of Carpenter's "The Microscope and its Revelations" (Seventh Edition, Edited by Dallinger, 1891), had at the time escaped my memory, otherwise it is extremely improbable that any such attempt would have been made.

It was found, however, that in actual practice the 4 mm., used in conjunction with a 27 compensating ocular, with which eyepiece the image remained perfectly sharp, would steadily show the fine transverse striæ on realgar mounts, although the lineation was much fainter than that revealed by oil-immersion lenses of large aperture.

The resolution of valves in realgar having been accomplished, dry and balsamed specimens were next examined, and to my very considerable surprise, both proved resolvable with the 4 mm. and 5-6ths axial cone. In balsam the striæ appeared as extremely faint, but clean, gray lines of great fineness. Although most faint and difficult, they have been held with perfect certainty for short intervals, slightly averted vision proving of material assistance in this instance.

In order to satisfy myself that the true striæ are indeed rendered visible by the 4 mm., a valve has been first arranged to exhibit them under that lens, an oil-immersion being afterwards substituted, when the lines have been found to be identical, and of the same fineness and distance apart with both objectives, the only difference being in the strength of the resolution afforded by them.

The significance of the above results is at once apparent on turning to the aperture table, where we find that N.A. .96 is given as the *limit* of resolution of the *A. pellucida* ;

hence it would appear that the Zeiss 4 mm. of N.A. .95 (nominal), illuminated by a 5-6ths solid axial cone, is in practice capable of revealing structure just within the theoretical resolving limit of a lens of N.A. .96, and that this resolution is attainable not only in media of high refractive index, but also in balsam and with dry mounts.

Now the 4 mm., although its guaranteed minimum N. A. is only .95, as a matter of fact is quite likely to possess an N.A. of .96, or even one slightly in excess of this, so that theoretically, without any deduction for technical imperfections, it would be just capable of resolving the *A. pellucida*; but that this theoretical limit should be actually attained by a lens with strictly axial illumination, and on specimens mounted in media of both high and low refractive index, cannot be regarded as a very extraordinary and interesting result, it having been hitherto considered that the transverse striæ of the *A. pellucida* are in actual practice only just discoverable with dry achromatic lenses of N.A. 1.0, and that only on the specimens mounted in a medium of about 2.4 refractive index when illuminated by oblique light in one azimuth along the valve.

Perhaps not the least interesting and satisfactory outcome of these observations is the indication that a dry lens is capable of working its full theoretical capacity on balsam-mounted objects, the resolution only becoming more conspicuous in media of higher refractive index.

In addition to the *A. pellucida* many other forms have been recently studied with the 4 mm. and a 5-6ths solid axial cone. The most difficult structural features have not been seen with a lesser cone, but we do not assert that they may not possibly be so resolved, although the results of my observations have strongly inclined me to the belief that, with axial illumination, structure just within the capacity of the lens employed can only be seen with a very large cone. It has appeared to me that closing down the cone, while greatly strengthening the contrast of the

coarser, causes the finer detail to disappear altogether, and materially reduces the separating power of the objective. With reference to this matter the following experiment may prove interesting :—Arrange a Cherryfield *Navicula rhomboides*, mounted in a mixture of monobromide of naphthaline and balsam, under a good semi-apochromatic $\frac{1}{4}$ " of N.A. .77, and 27 ocular, so that the valve shall lie longitudinally along and on the sharply focussed edge of the lamp flame. With slightly under $\frac{1}{2}$ cone the longitudinal striæ will appear conspicuous throughout the entire length of the valve, while the closer transverse striæ, although they may be seen to a certain extent, are far less satisfactorily defined, no thoroughly clear separation being apparent. Now replace the smaller by a 5-6ths cone. The coarse strongly-defined longitudinal striæ disappear, and at the first glance all structure may seem to have disappeared with them, but a little careful scrutiny will reveal the presence of a faint dotted resolution, the transverse divisions of which are as fully and cleanly shown as the longitudinal.

I am aware that the results dealt with in this paper cannot meet with general acceptance until they receive confirmation at abler hands than mine, nor indeed would it be desirable that they should be so accepted, involving as they do important theoretical considerations, until independent practical experience shall have placed their truth beyond doubt.

The subjoined notes on some of the forms lately examined with the 4 mm. may be of interest. A very large central solid cone has been invariably employed in conjunction with either Gifford's or the beautiful new acetate of copper screen.

Nitzschia curvula Sm. This diatom is mounted next to *Amphipleura pellucida* on Moller's dry "Probe-platte." Transverse striæ close and delicate, but undoubtedly resolved.

Nitzschia sigmatella Grun. Moller's balsam type slide. Transverse striæ extremely faint and difficult. A delicate object even with N.A. 1.3 and 1.4.

Nitzschia linearis and *N. obtusa* Sm. In balsam. The former very faintly resolved into transverse striæ, the latter not so difficult. Dr. H. Van Heurck, in his "Synopsis des Diatomees," gives *N. linearis* as having 27 to 30 striæ in 0.01 mm. (25.399 mm. = 1 inch), and *N. obtusa* 26 to 27 in 0.01 mm. *N. sigmatella* Grun., is given at 25 to 26 striæ in 0.01 mm., but the specimen of this form on the type slide has much finer structure than *N. linearis* and *N. obtusa*.

Nitzschia sigmoidea Sm. Moller's dry "Probe-platte"—25½ to 26 striæ in 0.01 mm. according to Van Heurck. This is remarkably easy with the 4 mm., the striæ presenting a beaded appearance. They can be certainly seen with the 12 mm. apochromat of N.A. .65, so do not probably, in this instance, exceed 55,000 to the inch. A specimen in balsam is also very easy with the 4 mm.

Nitzschia sigma Sm. Van Heurck gives 22 striæ in 0.01 mm. Distinctly dotted in balsam, and very easy in mixed monobromide of naphthaline and balsam.

Grammatophora oceanica Ehrenburg. = *G. subtilissima*. Moller's dry "Probe-platte." Resolved into transverse striæ. Van Heurck gives 30 striæ in 1.01 mm. for the *G. oceanica* var. *indica* Grun., and 30 to 31 for the *G. oceanica* var. *novaezeelandiae* Grun. Some specimens of *G. subtilissima*, however, are finer, running at about 88,000 to the inch.

Navicula crassinervis. Striæ 34 to 35 in 0.01 mm. according to Van Heurck. This has proved a most delicate object with the 4 mm., both dry and in realgar. With N.A. 1.3 and 1.4 realgar mounted valves are sharply resolved into dots, but the transverse striæ have alone been seen with the dry lens.

Hyalodiscus subtilis. In a mixture of monobromide of

naphthaline and balsam. Dotted structure on outer zone well seen, although faint and difficult near the edge of the disc. In balsam mounts the structure appears still fainter, but nevertheless may be traced nearly to the outer edge, where it runs at about 76,000 to the inch.

Surirella gemma Ehrbg. In realgar the beading has been seen beautifully defined with the valve arranged longitudinally on the sharply focussed edge of the lamp flame. Specimens mounted dry, in balsam, and in quinidine, have been also examined, but their complete resolution has proved a much more difficult matter.

Colletonema vulgare. Moller's balsam type slide. This has been most carefully studied with the 4 mm. The resolution is very faint, and requires particularly exact focal adjustment, but when once seen it can be held fairly steadily without any great difficulty. Dr. Van Heurck writes of this diatom, "Stries fines, délicates, les moyennes faiblement radiantes, les terminales parallèles, environ 34 en 1 c.d.m.; les stries médianes plus fortes, plus écartées, 24 en 1 c.d.m. et plus radiantes."

Navicula major. Moller's balsam type slide. The full resolution of the structure of the bands on the hoop of this diatom is by no means easy, even with the Zeiss 3 mm. apochromat of N.A. 1.4. Notwithstanding this, the resolution is carried very far by the 4 mm., the striæ appearing remarkably black, crisply defined, and well separated, their beaded nature being quite recognizable, although not so fully revealed as with the oil-immersion. On this specimen the striæ alone are just visibly separated by the 12 mm. apochromat, 5-6ths axial cone, and a Huyghenian eyepiece magnifying about 45 times, the 27 compensating ocular not proving sufficiently powerful for the purpose with this objective.

COMMENTS BY DR. E. J. SPITTA.—To enable an object consisting of lines separated by minute intervals, or dots, or any small structures, to be seen, two conditions were

absolutely necessary. First, that such objects should be sufficiently magnified for the eye to be capable of seeing them; and secondly, that the N.A. of the objective should be high enough to render such objects sufficiently resolved; for every one in the room was familiar with the fact that mere magnification without sufficient N.A., or "empty magnification," as Professor Abbe called it, was as useless as N.A. without the proper amount of magnification.

Now with regard to the first condition. It was supposed that 1-250 inch represented the minimum distance that two objects, whether lines or dots, must be separated for the normal human eye to see and separate them distinctly at a distance of ten inches. No lines or dots closer than this could be recognized in their individuality. In other words, no matter what might be the real distance between any two dots or lines on a diatom they must, by optical means, be so rendered to the eye, when looking down the microscope, that they did not appear closer together than 1-250 of an inch. It was more convenient for them to be magnified a little more, so as to be separated apparently by a greater interval, because in that case those whose eyes were not absolutely normal would see them better; but anyhow they must not apparently be separated by an interval of less than 1-250 of an inch. The lines on *Amphipleura pellucida* were mostly about 100,000 to the inch, so to see them with the microscope the entire optical arrangement must result in magnifying at least 400 diameters, because $400 \times 250 = 100,000$. Now, how did the author obtain his magnification, and what was it? He used a $\frac{1}{4}$ in. objective and a 27 eyepiece. Well, that equalled a magnification of 1620, because the initial magnifying power of a $\frac{1}{4}$ in. was about 60, and $60 \times 27 = 1620$. He had, therefore, plenty of magnification. But what about the N.A.—the second condition?

Abbe's law which was based on mathematical considerations admitting of no controversy, declared that, with

the smallest possible beam of truly axial illumination, the number of lines to the inch capable of being resolved $= x \times N. A.$ where x is the number of wave-lengths to the inch of the light actually used. Putting this into actual figures, seeing that there are about $47,500 \times .95$ gave 45,125 lines to the inch as the theoretical limit—a long way off 100,000. In other words, the lines must not be closer than 1-45125 of an inch. But with oblique light this formula was doubled, and became $2x \cdot 95$, or 90,250 to the inch, or 1-90250 of an inch apart. It was evident, then, that Mr. Merlin could not have seen lines 1-100000 or even 1-90000 of an inch, apart without oblique light, using only a 5-6ths cone of axial illumination; and this justifies the original remark that his specimen must have been a coarsely marked one. It was theoretically possible that the author might possess a photographic eye, so to speak: one that received impressions in the violet-blue ray as well as ordinary individuals did in the yellow-green or so-called "visual ray," but he had never heard of such a case.

As the formula already given applied to any ray, it should be possible to photograph on a plate what cannot be seen with the eye. The 100,000 lines to the inch could only be seen most faintly with the .95 objective, but inasmuch as the wave-length of *photographic* light was about 1-62500 of an inch, twice that $\times .95$ gave a photographic limit of a little over 100,000 lines to the inch. His son, and himself had tried to do this. As they could focus the lines on the ground glass screen of the camera, they had to make trial and error exposures, and failed several times, but at last succeeded in just showing the lines.

Seeing things with a direct solid cone was no doubt very much better and more to be relied upon than seeing them by oblique light. An object with large markings well seen by direct light appeared simply gray with oblique light. If the lens employed was a fine one and the lines were very fine they could be seen with oblique light,

but if they were coarse they were lost sight of by virtue of their largeness.

COMMENTS BY E. M. NELSON.—Mr. Merlin used the telescope, till his eyesight was exceptionally keen, which was probably as good if not better training for the eye than the microscope. The fact of one being unable to see any particular structure described in this paper would not, therefore, be evidence that Mr. Merlin was likely to have been mistaken in what he had seen. He had tried a 5-6th cone with the dry 4 mm. apochromat of .95 N.A. with the $\frac{1}{2}$ -inch wick of a paraffin lamp and an acetate of copper filter, but was not able to effect resolutions to anything like the extent Mr. Merlin had done. He next tried sunlight with a heliostat, but the heliostat proved untrustworthy and the sunlight fickle, so he was not able to push his experiments as far as he would have liked. He found, however, that with sunlight he could use a filter of much greater thickness, and then he was able to see some of the structures. There was another point—viz., that the Abbe diffraction theory did not fit in with all the observed phenomena bearing upon that branch of microscopy. It was highly probable that the large solid axial cone had a greater resolving power in it than was generally supposed. His experience showed him that 80,000 times the N.A. of the objective was the resolving limit in inches with this kind of illumination, but from what Mr. Merlin had said it was evident that a larger coefficient must be employed. The little beads in the lines on the hoop of a *Pinnularia major* were, so far as he knew, unresolvable by oblique light, but with the 5-6ths solid axial cone he had been able to see them with the dry 4 mm. apochromat. Strange to say, this same object had in 1895 been a kind of minimum visible or crucial test for an apo. $\frac{1}{2}$ " of 1.43 N.A. It appeared, therefore, that the "minimum visible," the "crucial test," the "scarcely resolvable detail" of one year became the commonplace object at a

subsequent period. This, Mr. Nelson said, had been his frequent experience during the quarter of a century he, had been actively engaged in microscopical work.

Does Rabies Originate Spontaneously?

D. E. SALMON, D. V. M.

Most of the older writers on rabies, those whose writings appeared before 1865, admitted that the disease might develop spontaneously in the bodies of certain animals as a result of certain conditions of life and atmospheric influences. These same writers believed that most other contagious diseases frequently originated in the same manner. It was a time when the spontaneous generation of many living things was frequently admitted, and when the ignorance of the nature of all kinds of contagion, with the exception of the larger animal parasites, was complete and impenetrable. Science had not yet definitely passed upon the doctrine of the spontaneous and continuous generation of living matter.

It was not a very long time before this when it was believed that the mite which causes scabies or itch was continuously developed spontaneously, and that it was folly for people to try to protect themselves from this disease. About the same time, or possibly a little earlier, it was thought that lice were spontaneously developed, and that both the domesticated animals and mankind were doomed to suffer from them for all time. Still earlier there was a common belief that crocodiles and other animal life developed spontaneously from the mud of the rivers and lakes in which they were found.

The study of natural history and the progress of science disproved one by one these ancient beliefs, and made it clear that all animals developed from pre-existing animals of the same kind. Even lice and the mites of scabies were found to be subject to this invariable law of nature,

and the eradication of such pests was taken up with energy and perseverance. The rarity with which these parasitic pests are encountered among civilized people of the present day proves the value of correct views upon such questions.

The last point to be yielded by the believers in spontaneous generation was the origin of the protozoa and bacteria, microscopic animals and plants so small that their life history could be studied only with great difficulty. It was finally shown, however, that even these infinitely small organisms obeyed the general law of nature and propagated and developed from ancestors, each species after its kind, and that in the absence of ancestors not even these low forms of life could appear.

About this time it began to be suspected that the cause of the contagious fevers was microscopic organisms, which were able to live a parasitic life in the bodies of men and the larger animals. After many observations pointing in that direction it was finally demonstrated in 1876 that the cause of anthrax was a bacillus, and shortly afterwards that fowl cholera, septicæmia, hog cholera, tetanus, black-leg, tuberculosis, and various other diseases were due to similar microscopic vegetable organisms, each disease being caused by its own distinct species of germs. It was also shown that malaria, Texas fever, and some other diseases were caused by microscopic animal organisms belonging to the protozoa, and that here again each disease had its own definite and distinct species. In every case the minute plant or animal parasite had its own definite form and certain biological characters by which it might be distinguished from all other living things. Each species multiplies and propagates its kind, and there is no more evidence here than elsewhere in nature to sustain a doctrine of the spontaneous appearance of living things.

The first effect of these scientific demonstrations was to clear away a vast amount of rubbish which had accu-

mulated in the standard teachings as to the cause of contagious diseases. If, for example, anthrax is caused by the *Bacillus anthracis* gaining entrance to the interior of the body and multiplying there, and if the disease cannot be produced in the absence of this bacillus, then it becomes plain that the disease is not caused by electrical disturbances of the atmosphere, by too much food or too little food, by forage containing too much water or that which is too dry, by intense heat of summers or extreme cold of winters, or indeed by any of the other influences to which the development of the disease has been usually attributed. It was contact with substances containing the bacillus which produced the disease, and when this bacillus gained access to the animal body the disease developed without reference to the atmospheric conditions, the food, or the other elements of the environment.

The comprehension of this fact led Bouley and other great pathologists to revise their opinions regarding the origin of many contagious diseases. It had been held that glanders originated spontaneously from overwork and insufficient food; that bovine pleuropneumonia developed as a result of exposure of cattle in the mountains of Europe to extremely low temperatures; that cattle plague arose spontaneously in eastern Europe, and particularly on the steppes of Russia, and that rabies in the dog resulted from unfavorable conditions of life. The demonstration of the germ theory of contagion, which was quite unexpected by the majority of medical men, completely overturned these old views, based upon an entirely different hypothesis. The idea of spontaneous development, of origin *de nova*, was generally abandoned, and the further scientific researches have been pushed, the more incontestible does it appear that the one and only factor of consequence in the production of these diseases is the entrance of the disease germ into the interior of the animal body, where it can multiply and disseminate itself.

If proper measures are taken to protect animals from the bacilli of anthrax, of glanders, of pleuropneumonia, they do not contract these diseases. Investigation of cattle plague in central Europe indicated that the disease always came from the East. Investigations on the steppes of Russia showed that it did not originate there, but came from the plains of Asia. Investigations in Asia indicate that even there the disease is always the result of contagion from some other affected animal. In the same manner, investigations of rabies failed to bring out any evidence to indicate that the disease might originate in any way except by contagion, that is by inoculation from an affected animal. It may, therefore, be accepted as practically certain that rabies does not develop spontaneously in any animal, but that it is always the result of inoculation from some other affected animal.

If the doctrine of spontaneous generation, or abiogenesis, has been abandoned by scientific men, it has by no means lost caste with many persons who consider themselves philosophers; and these persons hesitate to accept or indeed bitterly contest the conclusion of science, which has been outlined above. If, they ask, every dog with rabies contracted the disease from some other dog affected with it, how did the first dog get it? This is a question as to the origin of things, which we may with equal reason ask in regard to all living organisms. If every dog is brought into the world by the sexual union of the two other dogs, where did the first dog come from? This question is just as difficult, but no more difficult than the other. Because we have in our question implied the philosophical absurdity of a series of dogs without a beginning, we have not convinced anyone that dogs can originate in any manner except by ancestors of their own species, nor is the similar question as to the origin of the first case of rabies any better reason for accepting the theory of the spontaneous origin of this disease.

There are many diseases of which it may be said that in our time and in our country they arise only by contagion. Prominent among these are smallpox, scarlet fever, measles, cholera, tuberculosis, glanders, bovine pleuropneumonia, foot-and-mouth disease, and rabies. Recorded history does not tell us where and under what circumstances the first case of any of these diseases appeared, any more than it tells us where and under what circumstances the first dog appeared. We know by observation, and by observation alone, how dogs are propagated at the present day, and we accept observation as conclusive upon this point. Why should we not accept observation and experimentation as conclusive in regard to the propagation of a contagious disease?

While we can not reasonably expect at this late day to decide the cause of contagious diseases by speculation as to the first appearance among animals of such diseases, it is legitimate to make such an inquiry in order to obtain a better understanding of these plagues. Science has made great progress in explaining the origin of species, and even in tracing in general terms the development of life upon earth; and while it can not say definitely where, when, and how the dog originated, it has been made plain that in some prehistoric age the dog developed from some earlier and related animal form, not by a sudden transformation, but by gradual transition. And in the same manner this early ancestor of the dog developed from a still earlier ancestor, doubtless quite different from the dog as he is to-day. To be brief, in tracing the development of the dog, we should be obliged to go back, step by step, toward the dawn of creation, toward simpler and simpler forms of life, until the primordial germ is reached. Just where in this long series of succeeding forms or just when in the countless ages that have elapsed since the beginning of the series the disease known as rabies appeared it is impossible to say. It may have been in

comparatively recent times, and when the dog had arrived at substantially its present form and development, or it may have been in some previous geologic age, when the conditions of environment upon all parts of the earth were far different from what they are at the present day.

It is not to be supposed that the strange animals whose fossil remains prove their existence many thousand years ago were free from contagious diseases any more than are the animals which live to-day; but whether the diseases of the prehistoric animal species were propagated from animal to animal until our time, or whether they disappeared and were replaced by more recent plagues, it is now impossible to say.

A study of the communicable diseases indicates that most if not all of them are caused by parasitic organisms. Indeed, the animal body has become the host of a multitude of parasites, most astonishing because of the number of species and the great variety of forms. All of these parasites probably at one time in the existence of their species, or of the ancestors of their species, lived elsewhere in nature. Under certain conditions they were attracted to certain kinds of animals; they found they could live upon or within them; they adapted themselves to these new conditions; their form and their physiological requirements were gradually changed, until finally in the course of time they could not exist elsewhere. They were then strictly parasitic.

So far has this development and adaptation to the conditions of environment gone that we find different species and varieties of lice, of mites, and of worms living upon each different species of animals, and in most cases these parasites perish if transferred from one species of animals to another species. If, therefore, these parasites can not exist when transferred to a different species of animals from that upon which they have developed and to which they have become adapted, there is all the more

reason why they can not exist in nature elsewhere than upon or within the animal body. Hence, we find animal species living as parasites upon other animals, and having no individuals of their species living a non-parasitic existence. They have developed and have been modified since they began their existence as parasites, just as the species of animals living free in nature have been modified. Consequently, if an animal becomes infected with lice or mites at the present day it must get them from some other animal which bears them.

The adaptation and modification of the bacteria and protozoa which cause the contagious diseases has probably occurred in much the same manner as that of the larger animal parasites which we have been considering. The glanders bacillus has lived a parasitic existence in the bodies of animals of the horse kind for many thousand years. It is no longer able to multiply or live for any considerable time in nature outside of the animal body. It is therefore a strictly parasitic organism. The bacillus of tuberculosis is even further developed as a parasite than the bacillus of glanders, as it is much more difficult to cultivate in the laboratory even under the most carefully adjusted conditions. There is no reason to suppose that any bacilli exist in nature having the same biological characteristics as have the glanders and tuberculosis bacilli.

The exact form of the rabies virus has never been satisfactorily determined, but what we know of it leads to the conclusion that it is a parasitic organism of some kind, which has been modified by thousands of years of existence within the animal body, and which has no counterpart elsewhere in nature. Inoculation with it is easy; it has specialized as to the conditions of life to such an extent that it multiplies only in the brain, spinal cord, nerve trunks, and a few glands; it can not be made to grow outside of the body by any methods now known. All these

facts indicate an obligatory parasitic existence. When or under what conditions in the prehistoric ages of the past it first became parasitic can never be known, nor can we determine at this late day how long a time was required to transform it from an organism which was only occasionally or accidentally parasitic into one which could live no other but a parasitic life. What appears certain is that for more than two thousand years rabies has been the same disease it is to-day ; that it has been propagated by the same species of animals, manifested itself by the same symptoms, and produced the same fatal results.

It is not likely that other microscopic organisms will from time to time take up their habitat in the animal body and become obligatory parasites. There are a number of different bacilli now known which are capable of living in the flesh and causing fatal disease, but which only do this under accidental conditions. Among these are the anthrax bacillus, the bacillus of blackleg, the bacillus of malignant œdema, and the bacillus of tetanus, all of which are deadly in their effects on animals inoculated with them, but all of which lack some quality required for their rapid dissemination or for the ready infection of susceptible animals. Consequently, they do not usually spread from animal to animal. With slight modification the anthrax bacillus might become the most terrible of the known disease germs. But that such modifications require time and conditions not often found, is proved by the fact that though this disease has been known since the beginning of medical knowledge, the bacillus has in the memory of man made no progress as a disease-producing organism, but on the contrary appears less capable to-day of gaining entrance to the tissues than it was two or three centuries ago.—*Ag. Depart. Year Book, 1900.*

Terminology of the Study of Blood Normal, and Abnormal.**HARRY D. OBERT, M. D.**

The blood consists of a liquid basis or plasma, in which are found two great varieties of cells, the red and white. The red ones are termed erythrocytes and the white ones leucocytes. The red cells are bi-concave discs, dark at the edge and with a clear or bright spot in the centre due to their bi-concavity. When this spot shows very distinctly a pathological state exists which we term endo-globular degeneration. There is no nucleus in the red cells. The white ones are nucleated in various manners, according to their stage of development. In addition to the corpuscles, there exists the so-called blood plates. Blood plasma when obtained free from corpuscles is perfectly colorless in thin layers. The red color of the blood is not due therefore to the blood plasma, but is caused by the mass of corpuscles held in suspension.

The blood leucocytes which are by far the most interesting part of the blood to study, are divided up in different classes, depending upon their stage of development. The function of these leucocytes has been the subject of numerous investigations, particularly in connection with blood diseases, but it cannot be said that we possess any positive information as to the normal function of these cells. These cells are not all the same, histologically. Erlich's classification divides them into three groups ; (1) Oxyphiles or Eosinophiles, or those which stain with an acid aniline dye, the acid portion of the dye acting as the stain. (2) Basophiles, those staining with a basic dye. (3) Neutrophiles, those staining with a neutral dye. These white cells are nucleated, with one, two or more nuclei which change their type and may become the so called transitional, the terms then, being mono-nuclear transitional and poly-nuclear. Normally the reaction of the blood is alkaline owing mainly to the alkaline salts and

especially the carbonates of soda, which are dissolved in the plasma.

The specific gravity of human blood in the adult male may vary from 1,041, to 1,067. The number of red blood cells is about 5,000,000 to the cubic millimeter of blood in a healthy adult male, and about 4,500,000 in the healthy female. If this number is exceeded which is very rare, the condition is called Polycythemia; if decreased it is termed, Oligocythemia. One of the most marked instances of the former which occurs, is the very extraordinary increase of red cells which is often met with in cases of congenital cardiac disease in children, amounting to as many as 8,000,000 to the cubic millimeter. A similar increase is seen in Phosphorous poisoning. Beside the ordinary red blood cells, we find in health small red cells supposed to be immature red cells, and called microcytes, while we may at times find very large red cells or Megalocytes. Not only may the red blood cells change but the quantity of their hæmoglobin may also vary. Normal blood should contain 100 per cent, although we may have perfect health with the amount estimated at 85 per cent. This decrease is termed Oligochromaemia. In disease we find more or less marked alternation in the red cells themselves and in their coloring matter. The microcytes and the megalocytes already mentioned may become greatly increased in number. The red cells when they become deformed are termed Poikilocytes. Some red cells, which unlike ordinary red cells possess a nucleus and are capable of amœboid movement are usually given the very confusing name of Normo-blasts. Other cells have been found that contained pigment, or are vacuolized, or again so dim in appearance that they are called shadow corpuscles. The proportion of the white to the red cells in health is about 1 to 500, but a very great variation may occur. Thus after meals the white corpuscles are always increased so that the proportion may be 1 to 150. On the other

hand, after this primary increase they may be decreased and the proportion may be 1 to 800. Time of day is also a factor in producing variation.

The instruments employed to-day for the examination of blood consist essentially of the microscope which is used to determine the quality and the character of the red and white cells, their comparative number and the presence of parasites; the polariscope which is employed in the color test for the purpose of determining the proportion of haemoglobin or in other words, the ability of the corpuscles to carry oxygen to the tissues, or for example, to detect the presence of carbon, mon-oxide-haemoglobin. Last but not less important is the so-called Thoma-Ziess haemocytometer, which is a very delicate instrument used to accurately estimate the number of corpuscles in the blood.

Anaemia, which means a deficiency in blood and is represented or portrayed by two conditions, in one of which the pallor and other symptoms are due to a diminution in the number of red corpuscles, while in the other there is a decrease of haemoglobin in each corpuscle. In regard to the white corpuscles, we can find even more interesting data, since their variation in number, form and character is marked in some diseases. Practically all conditions of the blood which are pathological, represent disease in organs connected with the blood directly or indirectly and do not depend upon primary changes in this liquid, except in rare instances. There are several varieties of anaemia, the most important of which is the so-called Pernicious Anaemia, in that it progressively gets worse until death occurs in the majority of cases, although a few may recover. The pathology of this disease is not understood. It is characterized by marked pallor without loss of flesh, or to speak more correctly, the sub-cutaneous tissues are added to rather than robbed of fat. There are gradually increasing dyspnoea, failure of strength,

cardiac palpation, venous murmurs, some vertigo and tinnitus.

The blood shows a most extraordinary and continually diminishing number of red cells, until the number may amount to only 143,000 to the cubic millimeter. In addition the following points of great diagnostic importance are to be noted. First the individual red cell is richer than normal in Haemoglobin; second, many are larger than normal; third, the red corpuscles are deformed, some being ovoid, others irregular; fourth, there are present microcytes or small cells; fifth, there are nucleated red cells, and, sixth, we may find megalocytes and megaloblasts which have a plain staining nucleus. The megaloblasts are termed corpuscles of Erlich, since he claims that they are Pathognomonic of pernicious anaemia. Anaemia, depending upon lack of Haemoglobin in the corpuscles rather than a decrease in their actual number, is seen most typically in that condition termed Chlorosis. In this disease the corpuscular diminution is so slight that it may be totally ignored, but decrease in haemoglobin is very great.

In connection with anaemia, I may speak of Leukaemia which means a marked increase in white cells, more particularly the large mono-nuclear leucocytes. Pseudo-leukaemia or Hodgkins' disease must be differentiated from true leukaemia, by the blood examination, it being stated that in this malady there is usually but a slight decrease in red cells and no other marked changes.

The parasites of the blood occupy a vast field of study and are held accountable for the different fevers such as malaria, Tertian fever, Quartan fever and the so-called Aestivo-Autumnal fever. These parasites consist for a great part of the malarial germ of Laveran or the "*Haematozoon Malariae*," and the "*Filaria Sanguinis Hominis*." No more important addition to the study of disease from a diagnostic standpoint has been made than the discovery of the presence of a parasite in the blood of

persons suffering from malaria fever, a parasite which is always present under these circumstances, and in all probability acts as the cause of all malarial phenomena. The parasites are varieties of sporozoa which live inside of the cell of the individual attacked. The parasite of malarial fever occurs in three forms, namely, as that of Tertian fever, that of Quartan fever and the parasite of the already mentioned Aestivo-Autumnal. A parasite of Tertian fever is a small Hyaline colorless body which occupies but a slight extent of the interior of the cell. When quiet, the parasite is round like the corpuscle but if examined fresh, it will be seen to have active Amœboid motion. By the terms Tertian and Quartan, we mean as for Tertiana fever which occurs every two days and for Quartan every three days. We may have a double Tertian or in other words, a Quotidian type in which the attack occurs daily. The cause of the paroxysm at a stated time is explained by the fact that when segmentation occurs in the full grown parasite we may look for an attack. The Quotidian fever is explained by the fact that two sets of parasites operate, one set segmenting say to-day, and the other to-morrow. The Quartan parasite which causes an attack every third day in its earlier stage of development, looks very much like that of Tertian form, for it occurs as a small Hyaline Amœboid body filling a fraction of the corpuscle. It soon, however, develops the following differences: first, it develops a sharper outline; second, it is more refractive; third, the Amœboid movement is slower; fourth, the pigment granules are coarser and more important, they lie very quietly around the edge of the parasite; fifth, the corpuscle acts as host and does not increase in size and finally disappears. In the third form of infection, the Aestivo-Autumnal, we find small Hyaline bodies. They have ringed appearance and are sometimes very small. Suddenly this body becomes larger and the ring is lost. Then however an Amœboid movement takes

place and a true ring is formed. The Peripheral circulation in this disease contains very few parasites.

Filaria and by this term we mean a long slender worm-like body existing and swimming in the blood and lymphatics. The "*Filaria sanguinis Hominis*" occurs in three forms. First, the "*Filaria Diurna*" or that species existing by day. Second, the "*Filaria Nocturna*" or that which exists by night, and third, the "*Filaria Perstans*" or that one existing persistently at all times. The "*Filaria Diurna*" and the "*Filaria Perstans*" are confined to patients found on the west coast of Africa and adjoining districts, while the "*Filaria Nocturna*" is pandemic in the tropics, and endemic in certain sections of the United States. The *Filaria Perstans* has been practically proven to be the cause of the so-called fatal "sleeping sickness" of the Congo region.

Prognosis as determined by a blood examination in pneumonia shows in this disease as favorable if Leucocytosis is present, but is a bad sign if absent even in the mild cases and certainly points toward a fatal issue. Leucocytosis simply shows that the system is re-acting.

In diphtheria here again, the absence of Leucocytosis is a bad sign even in the mildest case. The phenomena should keep pace with the severity of the disease. The staining reaction is said to be proportional to the severity of the disease.. Also, in scarlet fever and Scarlatinal nephritis, "Eosinophile" is the good sign and its absence a bad one. As in the before mentioned, the Leucocytosis is proportional to the severity. The foregoing facts simply serve to show that a conservative prognosis should not be made without a thorough blood examination.

The blood corpuscle first makes itself known in the marrow of long bones from whence it passes into those long narrow cylinders the blood vessels, where it must meet its foes, must fight disease, be overcome or return victorious.

BIOLOGICAL NOTES.

L. H. PAMMEL.

MYXOBACTERIA.—Since the publication of Dr. Thaxter's excellent account of Myxobacteria in 1892, several papers dealing with this interesting group of bacteria have been published. The species though mostly American have also been found in Europe and Liberia in Africa. Zukal has found four species of the genus *Chondromyces* in Vienna. C. Lorrain Smith in a recent number of the *Journal of Botany* describes a *Myxococcus pyiformis* found on the pellets of the rabbit dung. This organism produces pear-shaped cysts of a bright pinkish-orange-color on a short transparent gelatinous stalk. The cocci are round or somewhat oval. The colonies in culture tubes are colorless or dirty white consisting of motile rods. (*Jour. Bot.* 39 : 69-72, 1f).

NEMATODE GALLS ON MARINE ALGÆ.—Ethel S. Barton describes nematode galls found on *Furcellaria fastigiata* and *Chondrus crispus*. Thus far little attention has been given to the subject of gall formation in algæ. The galls form irregular knobs, due to the fact that they exceed or equal in size the diameter of the main stalk. The cells below and around the galls contained small granules which seem to correspond to Van Tieghem's Floridean starch which consists chiefly of Amylodextrin. (*Jour. Bot.* 39 : 49-51, Pl. 418, f. 1-6).

MUSHROOMS.—Much interest has in recent years been manifested in the study of mushrooms in this country, partly because of their undoubted food-value. Hamilton Gibson perhaps did as much as anyone else to popularize the subject. But several botanists have done much to bring the subject before the public in an intelligent way. Among the earlier writers mention may be made of Curtiss, of North Carolina. Of the more recent contributions the valuable papers by Farlow and Peck should be men-

tioned. George F. Atkinson's book on Mushrooms (Studies in American Fungi, Mushrooms edible, poisonous, etc) not only takes up the morphology, but the development and characters by which many species may be recognized. In this book of something over 200 pages the common species are described and illustrated. The pictures are as good as the photographer's art and engraver could make them, and the printer has done his part well. The photographs in many cases show the natural habitat of the fungus. The spore prints and sectional views given show the structure at a glance. Notes on distribution, and whether poisonous or edible accompany the description so far as known to the writer. A good key to North America genera of the family Agaricaceæ and a key for families accompanies the volume, as well as a glossary of the more technical terms used in the work. Mr. Hasselburg furnished the matter applied to certain structural characters of mushrooms. The chapter on chemistry and toxicology was written by J. F. Clark. The recipes for cooking were furnished by Sarah Tyson Rorer. An excellent bulletin on mushrooms has also recently been issued by Prof. L. F. Henderson of the Idaho Agricultural Experiment Station.

EMBRYOLOGICAL STUDIES OF QUERCUS.—Very little work has been done in working out the life history of *Quercus* but Abram H. Conrad, has given us a good account of *Quercus velutina*. The material was quite refractory. Chromo-acetic and picro-acetic acid were the most satisfactory for fixing. Cyanin and Erythrosin proved good for early stages and Delafield's hæmatoxylin for the archesporial stage and fuchsin and iodine green for embryo sac and embryo. (Bot. Gazette, 29 : 408.)

SCLEROTINIA.—Prof. Ralph E. Smith, gives the results of his investigation on *Botrytis* and *Sclerotinia*, their relation to certain plant diseases and to each other. He comes to the conclusion that *Sclerotinia libertiana* and

Botrytis cinerea have no connection whatsoever with each other and that the former species has no conidial stage of this type. It shows at all times a mycelium composed of large branching septate filaments, averaging from 10-15 microns in diameter. Sclerotia are always produced abundantly in cultures and affected plants. The sclerotia are sometimes an inch long. The *Peziza* form is readily produced. The fungus is a good example of a facultative parasite. It attacks a great variety of plants. (Bot. Gazette. 29 : 369.)

STUDIES IN MYXOMYCETES.—E. Jahn in some cytological studies of one of the Myxomycetes, *Dictydium umbilicatum*, obtained best results in fixing with Flemming. He succeeded in obtaining good nuclei by staining with Hæmatoxylin, Safranin and Gentian Violet. He did not succeed in obtaining karyokinetic figures. Chromatin threads and nucleolus can be made out very readily. The *Dictydium* granules described here have not heretofore been recognized in any other group of these organisms. Chemically they are differentiated because of their resistance to acids and alkalies. The chemical nature was not determined. They do not give the chemical reaction for cellulose, though they may prove to consist of substance related to cellulose. (Ber. d. Deutsch Bot. Gesellsch. 19:97.)

TUBER-LIKE BODIES OF CYCAS.—Mr. A. C. Life discusses the tuber-like rootlets of *Cycas revoluta*. The coral-like outgrowths have been known for a considerable length of time and there has been much discussing as to their nature. The author has made cultures of the tubercles on agar and from these he raised three different bacterial forms, an organism resembling the *Rhizobium* of Schneider being obtained. The fungi and bacteria which are in cells in advance of the alga zone seem to prepare the way for the algæ. The author says it is difficult to speak with any certainty with reference to the symbiotic relations which exist between these various or-

ganisms. It has been suggested for certain plants that the converting of free nitrogen and simple nitrogen compounds into the more complex forms used by the plant is due to the nostoc. And the writer suggests the possibility of the use of nostoc forms in the cycads in the assistance of nitrogen assimilation. The tubercles then, have two functions, that of aerating, and that of assisting in nitrogen assimilation. (Bot. Gaz. 31 ; 265.)

MICROSCOPICAL MANIPULATION.

NEW METHOD OF EXAMINING SPUTUM.—Lanuoise and Girard (Arch. gen. de Med.) recommended the following method of examining sputum suspected of containing tubercle bacilli. It is based on the property possessed by the alkaline hypochlorites of dissolving mucous matter without the aid of heat. The sputum is put into a conical vessel, and covered by about 10 times its volume of a 33 per cent solution of chlorinated soda, and the whole well stirred up. It is then set aside for 24 hours, being given an energetic agitation from time to time. The disengagement of chlorine commences at once, and in 20 minutes globules of mucus and of pus (should the latter be present) are dissolved, the liquid becoming more or less turbid from the matters held in suspension. At the end of the time named, however, the suspended matter will have settled in the conical point and the supernatant clear liquid may be drawn off with a pipette. If a centrifugal separator is at hand, the operator can, of course, save himself the delay by operating on a single tube several times, decanting each time. When the volume of the material has been reduced to 2 or 3 c.c. there is added 5 or 6 drops of normal solution of sodium or potassium hydrate, (40 grams of NaOH or 56 grams of KOH to the liter of water). This transforms the residual chlorine into a chloride of sodium or potassium, as the case may be.

The mixture is allowed to stand, and the supernatant decanted. This leaves the material in condition to be fixed and stained by the processes of Zeihl or Ehrlich.

THE MICROSCOPIC EXHIBIT OF THE N. Y. BOTANICAL GARDEN.—This unique exhibit, both conceived and presented by Mr. William E. Dodge, has been temporarily installed in the hall of the west wing, and at present consists of twenty-four microscopes of special design mounted, by pairs, on twelve specially built oak stands, costing \$665.50. As this collection occupies a hall otherwise containing only cryptogams, it was decided to restrict the objects shown by the microscopes to specimens selected from the plants below the spermatophytes; thus the microscope exhibit enables a visitor to see the minute structure of the principal groups of the lower plants, from the myxomycetes or slime-moulds to the fern inclusive. Each microscope is accompanied by an explanatory label referring to the object shown by the instrument.

MEDICAL MICROSCOPY.

SARCOMA.—At the N. Y. Academy of Medicine, March 27th, Dr. Jonathan Wright said that the clinical history was entirely opposed to a diagnosis of melanotic sarcoma, as this was a specially malignant form of sarcoma. He had seen a number of apparent sarcomata of the septum in which, so far as the microscopical examination had gone, there had been nothing to distinguish them from malignant growths. In some of these cases the growth had been simply shaved off, and there had been no return. Where the clinical history contradicted the microscope in cases of suspected sarcomatous malignancy, he preferred to rely upon the clinical diagnosis.

SEA-WEEDS.—*Tabulæ Phycologicæ* by Fr. T. Kuetzing, in 19 vols. and index, has 1900 finely colored plates and sells for \$500. A Leipzig book-seller, whose address we

can give when requested by postal card, has undertaken to reprint volumes I-V, which alone are out of print, so as to sell complete sets for \$125. provided a certain number of orders appear. Kuetzing's unique work is the greatest in existence on this subject and is indispensable for the study of sea-weeds. Our readers should seek to influence wealthy libraries in the U. S., to supply our country with at least a few copies,—especially the Boston Society of Natural History; the Astor Library, New York; the Congressional Library, Washington; the Lloyd Library, Cincinnati; the Chicago University; the Mechanics Institute Library, San Francisco; the Carnegie Library, Pittsburg; the Fish Commission, Washington, D. C., etc. We will receive the orders for it in America.

MICROSCOPICAL SOCIETIES.

QUEKETT MICROSCOPICAL CLUB.—The 387th meeting was held on Friday, May 17. Among the donations announced was one of 51 mounted specimens of Rotifers, presented by Mr. C. Rousselet, for which a special vote of thanks was passed. The collection of these organisms now in the club's cabinets amounts to 250, and, as type specimens, are invaluable for study. Mr. Massee gave a description of the life-history of several new fungi belonging to the Laboulbeniaceæ, recently discovered by Dr. Thaxter, U. S. A. They are mostly found growing on aquatic larvæ, chiefly coleopterous. The affinities of this group, especially in their reproductive organs, with the red algæ, was pointed out and illustrated by a number of colored diagrams. The meeting then resolved into the usual conversazione, at which several interesting living organisms were shown, including Stephanoceros, Vorticella, Volvox, and others.

The Club contains 340 members of whom A. M. Edwards, M. D., and Prof. H. L. Smith, of Hobart College,

are Honorary ; S. W. Fletcher, M. D., Pepperill, Mass., and D. Bryce Scott of Moncton, N. B are Ordinary.

NEW PUBLICATIONS.

Das Mikroskop in Chemischen Laboratorium. By Dr. F. Rinne, 74 pp. 202 figs. 4 marks. Hanover. Optical properties of crystals and mineralogical microscopy get excellent treatment. Polarization and micro-methods are described in the German language.

Die Technik des Modernen Mikroskopes. By Dr. W. Kaiser, 80 pp. in each of two parts, 4 marks. Vienna. Instruments of German and Austrian makers are fully discussed. Optics and mechanics in these two parts are to be followed later by other topics. Great advances have been made by Viennese firms of Reichert, Merker and Ebeling since 1880.

Strasberger's Botany. Fifth Edition translated by Hillhouse, issued in London, 1900, 519 pp. 162 figs.

An Astrology.—By A. Alpheus. 217 pp. 12 mo. Until within a century or two, physicians always used astrology and they used it more than all other people but astronomers used it also. The great Kepler used it and was non-plussed because he failed in an attempt to predict the death of Wallenstein. The position of Uranus is now said to have caused it, but Uranus had not been discovered in Kepler's time and had to be left out of his calculations. One of the most eminent physicians of Boston secretly uses astrology and told this author during the first hour of acquaintance that this author, then totally ignorant of the subject, that he would become a leader in astrology. This book in small compass, opens the whole subject, is beautifully bound and will be sent with the Microscopical Journal of 1901 for two dollars. You cannot afford in ignorance to ignore the matter.

EUROPEAN TRAVEL.

Miss Weldon will take six young ladies abroad.

RESTRICTED

HIGHEST REFERENCES

Address, for prospectus of the trip,

Miss WELDON, The Moorings,

HOWARD, P A.

Specially Prepared Botanists Herbarium Paper.

This paper is offered at the moderate price of \$5.50 per ream
We also furnish.—

No. 1. Genus cover, 16½x24 inches, at \$ 4.00 per 100

2. " " " 2.50 "

3. " " " 1.50 "

Dryers, 12x18 " 2.00 "

Species sheets, 16½x23½ " .50 "

Orders will receive prompt attention. Write for samples.

E. MORRISON PAPER CO.,

1009 Pa. Ave., N. W., Washington, D. C.

100 per ct. Profit. No Grain, Stock or Turt
Speculation. Full par-
ticulars and more sample copies of choice magazines than
you could buy for several dollars mailed for 10 cents. West.
Per. Sub. Agency, 516 E. F. 2nd Ave., Milwaukee, Wis.



CARL REICHERT

MICROSCOPES.

SOLE AGENTS FOR UNITED STATES.

RICHARDS & CO., LTD.,

NEW YORK,

CHICAGO,

30 East 18 Street.

108 Lake Street.

Microscopic Preparations Illustrating the Minute Structure of Vegetable Life.

Being enclosed in a novel transparent envelope, these objects may be examined without removal before mounting. They are prepared with the utmost care by WALTER WHITE, England, and are mostly stained in one or two colors of the most permanent character.

A friend says: The sample section is exquisite. It is so good that I want more. As a well-cut and well-stained section it is equal to anything I have seen in that line.

PRICES.

Catalogue of 172 objects,	- - - - -	\$0.02
Single specimens,	- - - - -	.08
20 specimens, assorted,	- - - - -	1.00

CHAS. W. SMILEY, Washington, D. C.

Microscopical Specialties.

KING'S CEMENTS Have a first-class reputation, and they will sustain it.

KING'S GLYCERINE JELLY is unsurpassed.

THE KING MICROTOME is the best for botanical work

Send for full list of specialties.

J. D. KING, Cottage City, Mass.

THE FISK TEACHERS' AGENCIES, EVERETT O. FISK & CO., Proprietors.

President.

EVERETT O. FISK, - - - 4 Ashburton Place, Boston, Mass.

Managers.

W. B. HERRICK, 4 Ashburton Place, Boston, Mass.

Mrs. S. D. THURMOND, 1942 Twelfth St., Washington, D. C.

A. G. FISHER, 4 Ashburton Place, Boston, Mass.

MARTHA HOAG, 4 Ashburton Place, Boston, Mass.

HELEN G. EAGER, 4 Ashburton Place, Boston, Mass.

W. O. McTAGGART, 25 King St., West Toronto, Canada.

H. E. CROCKER, 70 Fifth Avenue, New York, N. Y.

W. D. KEAR, 70 Fifth Avenue, New York, N. Y.

F. V. HUTCHISON, 70 Fifth Avenue, New York, N. Y.

W. O. PRATT, 70 Fifth Avenue, New York, N. Y.

L. E. HALSEY, 355 Wabash Avenue, Chicago, Ill.

J. D. ENGLE, Century Building, Minneapolis, Minn.

Mrs. E. DOWLING ENGLE, Century Bldg., Minneapolis, Minn.

C. C. BOYNTON, 120 1/2 So. Spring St., Los Angeles, Cal.

Send to any of the above agencies for 100-page Agency Manual. Correspondence with employers is invited. Registration forms sent to teachers on application.

Microscopic Preparations Illustrating the Minute Structure of Vegetable Life.

Being enclosed in a novel transparent envelope, these objects may be examined without removal before mounting. They are prepared with the utmost care by WALTER WHITE, England, and are mostly stained in one or two colors of the most permanent character.

A friend says: The sample section is exquisite. It is so good that I want more. As a well-cut and well-stained section it is equal to anything I have seen in that line.

PRICES.

Catalogue of 172 objects,	- - - - -	\$0.02
Single specimens,	- - - - -	.08
20 specimens, assorted,	- - - - -	1.00

CHAS. W. SMILEY, Washington, D. C.

Microscopical Specialties.

KING'S CEMENTS Have a first-class reputation, and they will sustain it.

KING'S GLYCERINE JELLY is unsurpassed.

THE KING MICROTOME is the best for botanical work

Send for full list of specialties.

J. D. KING, Cottage City, Mass.

THE FISK TEACHERS' AGENCIES, EVERETT O. FISK & CO., Proprietors.

President.

EVERETT O. FISK, - - - 4 Ashburton Place, Boston, Mass.

Managers.

W. B. HERRICK, 4 Ashburton Place, Boston, Mass.

Mrs. S. D. THURMOND, 1242 Twelfth St., Washington, D. C.

A. G. FISHER, 4 Ashburton Place, Boston, Mass.

MARTHA HOAG, 4 Ashburton Place, Boston, Mass.

HELEN G. EAGER, 4 Ashburton Place, Boston, Mass.

W. O. McTAGGART, 25 King St., West Toronto, Canada.

H. E. CROOKER, 70 Fifth Avenue, New York, N. Y.

W. D. KERR, 70 Fifth Avenue, New York, N. Y.

P. V. HUYSSOON, 70 Fifth Avenue, New York, N. Y.

W. O. PRATT, 70 Fifth Avenue, New York, N. Y.

L. R. HALSEY, 355 Wabash Avenue, Chicago, Ill.

J. D. ENGLE, Century Building, Minneapolis, Minn.

Mrs. E. DOWLING ENGLE, Century Bldg., Minneapolis, Minn.

O. O. BOYNTON, 120 1/2 So. Spring St., Los Angeles, Cal.

Send to any of the above agencies for 100-page Agency Manual. Correspondence with employers is invited. Registration forms sent to teachers on application.

EUROPEAN TRAVEL.

Miss Weldon will take six young ladies abroad.

RESTRICTED

HIGHEST REFERENCES

Address, for prospectus of the trip,

Miss WELDON, The Moorings,

HOWARD, P A.

Specially Prepared Botanists Herbarium Paper.

This paper is offered at the moderate price of \$5.50 per ream
We also furnish.—

No. 1. Genus cover, 16½x24 inches, at \$ 4.00 per 100

2. " " " 2.50 "

3. " " " 1.50 "

Dryers, 12x18 " 2.00 "

Species sheets, 16½x23½ " .50 "

Orders will receive prompt attention. Write for samples.

E. MORRISON PAPER CO.,

1009 Pa. Ave., N. W., Washington, D. C.

100 per ct. Profit. No Grain, Stock or Turt
Speculation. Full par-
ticulars and more sample copies of choice magazines than
you could buy for several dollars mailed for 10 cents. West.
Per. Sub. Agency, 516 E. F. 2nd Ave., Milwaukee, Wis.



CARL REICHERT

MICROSCOPES.

SOLE AGENTS FOR UNITED STATES.

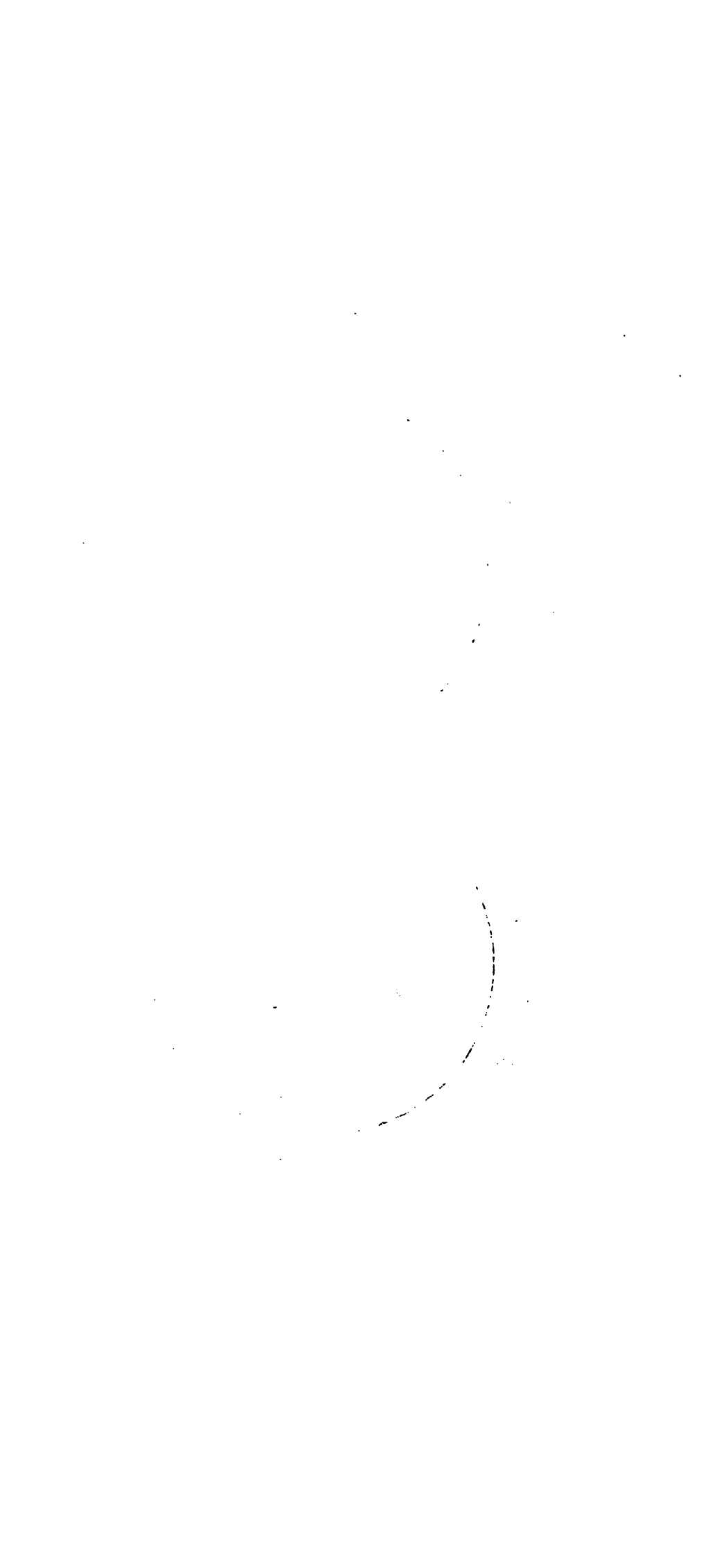
RICHARDS & CO., LTD.,

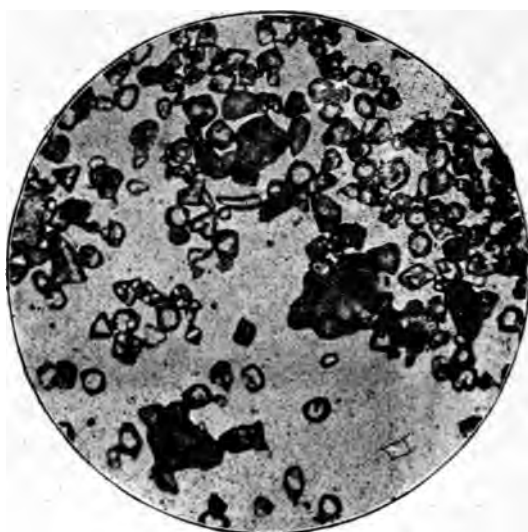
NEW YORK,

CHICAGO,

30 East 18 Street.

108 Lake Street.





ARSENIC FROM WHISKY



ARSENIC FROM MALT MILK

THE AMERICAN

MONTHLY

MICROSCOPICAL JOURNAL.

Entered at the post-office as second-class matter.

VOL. XXII.	JUNE, 1901.	NO. 6.
------------	-------------	--------

CONTENTS.

Comparison of Samples of White Arsenic. Bartow. With 6 photo-micrographs	151-156
Sketch of Thomas Henry Huxley. Book review.....	156-158
British vs. Continental Microscopes. Cross	159-161
Instantaneous Photomicrography. Scales.....	175-177
NOTES BY CROSS.—Staining Living Bacilli; Substage Condensers; Illumination with Lamps; Photo-micrography with Arc Lamps; Staining Flagella; Fine Adjustments; Reichert's; Leitz's Workshop at Wetzler; Quekett Club; Ringing Slides.....	161-172
NOTES BY L. H. PAMMEL.—Cyperaceæ; Haustoria of Erysiphæ; Centrosomes; Bacterial Diseases of Plants.....	173-175
MICROSCOPICAL MANIPULATION.—Bleaching Bone; Coloring Matter of Algæ.....	177-178
BACTERIOLOGY.—Widal's Reaction in Typhoid; Denver College; Preservation of Eggs; Trichinæ in Pork	178-180
International Association of Botanists	180

Comparison of Samples of White Arsenic.

EDWARD BARTOW.

With Frontispiece.

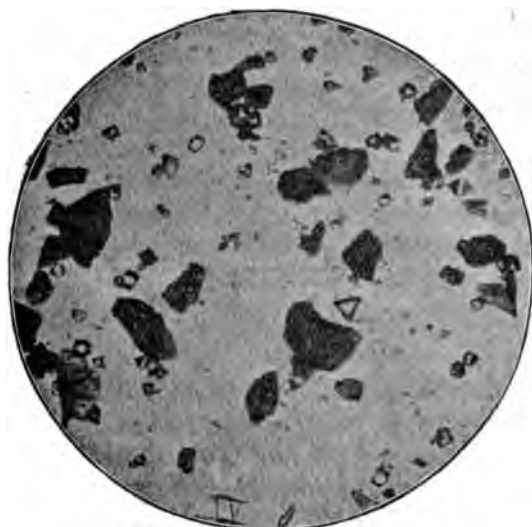
In a recent case of suspected poisoning in this state, a bottle of malted milk was brought to me for examination. I found evidence of the presence of arsenic by the Marsh test, and by the Reinsch test; and even the simple test of heating the substance with a piece of charcoal, in a glass tube closed at one end, gave a heavy arsenic mirror.

Considering the greasy nature of the material under examination, I conceived the idea of separating the crystals of white arsenic, if the arsenic should be present in that form, by means of ether. On panning the malted milk with ether in a shallow porcelain dish, I was enabled to

separate quantities of the crystals in a pure state. An attempt to do this with water failed. In fact, water could not be used on them until they were free from the fat.

A few crystals of white arsenic were separated from a bottle of whiskey found on the premises of the deceased.

In following up a clue that seemed to point to the source from which the poison might have been obtained, the county attorney submitted to me a sample of white arsenic crystals obtained from this source. He requested me to determine whether they were like those found in the malt-



SUSPECTED SAMPLE. $\times 75$.

ed milk or in the whiskey. To my knowledge, the only work of such a nature is that of Professor E. S. Dana. Professor Dana enters into an exhaustive account of the methods of preparing white arsenic, and of the possibilities of differences due to the variations of the conditions during the process. He also made microscopical examinations of many samples of commercial arsenic, and deduced the following conclusions: "The study of a large number of independent samples of commercial white arsenic confirms the conclusions based upon the observations

as to the method of manufacture, and shows that wide variations in character often exists. These differences, when they occur, are readily distinguishable by the microscope and, in most every case, it is, by this means, possible to conclude, of two test samples, whether they could or could not have come from the same source ; and this is true, under favorable conditions, even if one of the samples has been subjected, for some time, to the action of the stomach."

The work of Professor Dana is well known, but at first I had only at command the limited notice given to it in

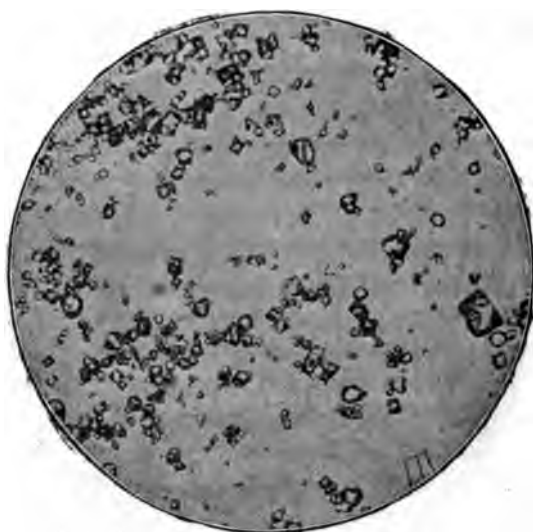


SUSPECTED SAMPLE No.2. $\times 75$.

the works on toxicology. Later I received the article of Professor Dana, which he kindly sent me, and was interested in carrying out more in detail the methods of work which he describes. My method of work was as follows :

I mounted a few slides of each of the samples (the limited amount of crystals separated from the whiskey made but one slide) as well as samples of white arsenic from the laboratories of the university and from the drug stores of the city. Differences were so marked that I at once concluded that the sample submitted by the county at-

torney and the arsenic from the malted milk could not have had the same source. To assure myself that the treatment with ether had not changed the character of the crystals from the malted milk, I mixed some of the arsenic from the suspected source with pure malted milk, using the same proportions as were found in the malted milk containing the poison, then panned out the arsenic in the same manner as from the original sample of malted milk. Several slides were made with the arsenic treated in this

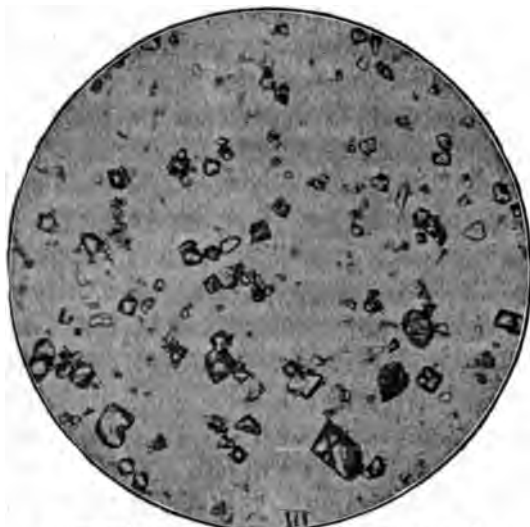


Arsenic from Chemical Laboratory. $\times 75$.

way. After the process there was no difference in the appearance of the sample.

In the microscopical examination, I noted the size of the crystals, the size of the amorphous bodies present, the character of the amorphous bodies, and the relative number of crystals and amorphous bodies. We may thus summarize the observations of the crystals from the milk, the whiskey, and the suspected sample. The crystals from the suspected sample were the smallest, those from the whiskey were the largest, though not much larger than those from the malted milk. The amorphous bodies were

of a similar size in each sample. In each case were some much larger than the crystalline bodies. Those from the milk were of a transparent nature, while the others were opaque. In the suspected sample, about 25 per cent were well shaped crystals. In the sample from the whiskey about 15 per cent were crystals. That from the malted milk showed about 40 per cent of crystals. From these differences I concluded that the arsenic in the suspected sample could not have had the same source as that found in the milk and the whiskey.



Amorphous arsenic from pharmacy. $\times 75$.

In order to be sure that my separation of the various slides into groups was not due to my familiarity with them, I submitted these slides, together with slides prepared from arsenic from other sources, to Professor S. W. Williston, to Professor W. C. Stevens, and to Professor E. Haworth. Each had no difficulty in separating the slides submitted into groups, always putting those from the same source into the same group, and never classifying the suspected sample with the specimens from the milk and the whiskey, thus confirming my own conclusions.

All the comparisons were made directly from the slides, and, in fact, a better judgment can be formed by observing a considerable portion of each slide. I have, however, had a number of photo-micrographs made by Mr. F. E. Marcy the university photographer. These show the crystals magnified seventy-five diameters and give a very good illustration of the variations in the various samples. I have added also photographs of samples from specimens of white arsenic in the chemistry and pharmacy laboratories of the university, because they show a great variation in the percentage of crystals, though the particles are nearly of the same size.—*Kans. Univ. Quarterly.*

“Sketch of Thomas Henry Huxley.”

By T. Chalmers Mitchell of London. 297 pp. 8 vo, 6 plates including portraits of Huxley, Darwin, Charles Lyell and Jos. Dalton Hooker.

Huxley was born May 4, 1825 and died June 29, 1895. From 17 to 20, he studied medicine and, in 1846, sailed on Her Majesty's Gun-ship, *Rattlesnake* for the Australian seas. Though only its surgeon, he became in reality its Naturalist and through the study of minute forms became at this early age a skilled microscopist. This book, therefore, appeals to every owner of an instrument. Besides, it is published by Putman's Sons in their best style at a fair price (\$1.50). Huxley, at 60, told the boys in the Royal College of Science that when he was of their age he had to have his microscope lashed to the mast to get a glimpse of the forms that he was exhibiting to them in slides prepared at Naples. He said, however, that the difficulties of the past were often exaggerated, that with good light and a good lens together with the ship tolerably steady he never failed to get all the facts he sought, that the great thing was the good supply of specimens day after day because delicate oceanic forms deteriorated so rapidly. He did not mind the cramped quarters, the tiny cabin, the jostle of ship's crew, the absence of books,

the lack of instruction or of learned companions. He had the sense to see and to rejoice in the advantages offered thereby. When Huxley cruised, the microtome was unknown. But tissues of animals too large to be examined or too opaque were either teased by needles which destroy the setting or were sliced by razors in a coarse manner. This was tedious and necessitated skill else considerable portions would be destroyed, misplaced or mutilated. But Huxley did more, be it known, through surmounting these obstacles than the army of highly pampered students of today who are provided with Minot's giant microtome, plus many accessories, by means of which tissues are embedded, hardened, cut to an incredible thinness and furnished in series of 100 or 500 sections. The study of forms has been revolutionized, and new methods require volumes for their obituaries since they pass away to make room for others. Our boys stuff their heads in college with the thoughts and methods of other men and all to little account. Huxley at 22, on the war vessel, did effective work which fools have said was due to genius though they have never told us the source of genius. Study and imitate Huxley, oh boy of poverty and of mediocrity, as portrayed by this writer rather than in the volumes from which he has segregated the data and you will see that latent genius is yours, that "self-reliance" is the father of genius and patient absorption its mother.

While Huxley had and genius possesses "self-reliance" it does not include self-esteem and self-indulgence. Self-reliance is an unconscious reliance upon a certain not-self within. Genius always alights upon the banner of that man. Huxley never accomplished anything with a homogeneous oil-immersion, one-tenth. His soul qualities did not require such a tool. An oil-immersion has NEVER enabled a man to get wisdom or a reputation from genius, since he would then rely on the lens and not on intuition. Huxley was driven, on the Rattlesnake, to rely on a some-

thing which I call intuition and which the world has called genius. Here is a lesson for every young microscopist and every naturalist who will study this volume.

Huxley became president of the Royal Microscopical Society but he never "fought lenses." The world will never know him as a microscopist, but the microscopists will always claim him. Of course, if he COULD have used modern lenses and appliances without the sacrifice of any advantage he possessed, his discoveries would have been far greater. For example, with all his study of *Medusæ*, he was never able to discover its nervous system which the highest powers now reveal.

We are told that Huxley was not in any sense of the word a collecting naturalist nor did the naming and classifying of species interest him. In such practices, lays the key to the insignificance of nearly all American college professors and the waste of time by all her students. Huxley wanted to examine "the architectural and engineering part of the business; the working out of the wonderful unity of plan in thousands of diverse constructions, and the modifications of similar apparatuses to serve different ends."

Of Huxley's magnificent contributions to the up-rooting of theological dogma, this is not the place to speak and those interested are referred to Mitchell's sketch which is so sensible, so just and so free from abstruse technicalities that every boy of sixteen who takes kindly to Nature should be presented with a copy at the same time that he acquires a microscope. While Huxley was a prominent contributor to the *Quarterly Journal of Microscopical Science* he was a true philosopher. While he was not a churchman, he saw the Infinite Omnipresence in nature and adored it.

We are taking subscriptions to Kutzing's 19-volume work (1900 plates) on the Sea-weeds. Send for circular. C. W. S.

British Versus Continental Microscopes.

M. I. CROSS.

For accurate original research, where the worker has some understanding of the mechanical and optical means at his disposal, there is no microscope in the world to be compared with the best of those produced by the leading British houses. In them are to be found refinements of mechanical skill which, suitably employed, call forth a response from objectives and condensers which causes them to yield their very best effects. Even in the British models of medium size and modest cost there are to be found several that are but slightly less effective than the largest, and with which no Continental stand can vie.

Yet the British microscope plays but an insignificant part, numerically, in the world's supply. In laboratories and in places where microscopes are largely used, the Continental instrument holds sway and seems likely to maintain it, at any rate for the present. The question of price is not the factor in the existing state of things, for even in students' stands the British manufacturer keeps his rates at the competitive mark. Why then is it that he does not receive a larger share of appreciation and home support?

The reasons usually given appear to be two in number, and are— (1). The British microscope exceeds the needs of the laboratory worker and student; (2). The casing and general "fit up" is inferior. The first is distinctly a laboratory cry, and may be regarded as due to want of appreciation and education in matters microscopical. The second is more general in its application and in a lesser degree influential.

To do the largest amount of work in the least possible time with the most cut and dried materials is a spirit which pervades the present day, and it applies to microscopical as much as to other spheres of activity.

The laboratory worker wants as much done for him as possible, so that it may only be necessary for him to place his object on the stage and "spot" the structure. To get the best from lenses and condenser is not in his province. "Numerical aperture," "aplanatic cone," and "critical image" are, as a rule, vague terms to him. Hence it comes that an instrument that always has its substage condenser approximately focussed and centred, and the mirror fixed in the line of the optical axis, saves him time and bother and suits his methods of working.

No one can defend the use of what are in reality but rough and ready means of examination of structure, and no reliance can be placed on deductions made from such methods. We are among those who are sanguine enough to hope that in the no very distant future, the advantage of perfect control in manipulation, and a rigid tripod foot, as provided in the majority of British microscopes, will supersede the Continental model.

This can only be brought about by a demand for more thorough teaching of microscopical principles and manipulation, and if good work is to be done in English laboratories it should be seen to that those who use the instruments shall get the best possible out of them. If this necessity were recognized and taken up vigorously by the scientific world—and many know full well how much it is needed—a different state of things would in time prevail. We would not advocate the pandering to a low degree of appreciation by reducing either the calibre or working accuracies of the instrument. Let us all do our best to raise the users to a higher level.

Meanwhile, the British manufacturer has opportunities of making his instruments more acceptable in several ways, and especially in the casing and general "fit up."

A great improvement has taken place in recent years, but there is yet room for further effort. Generally speaking, British houses are inferior to their Continental rivals

in this respect. It must be remembered that the horse-shoe foot is more easily gripped and held firmly in its case than the tripod, but a strong and neat fitting for the latter ought not to be beyond the powers of the ingenious to contrive.

It may be fearlessly stated that a good day is coming yet for British microscopes if the makers do but set their houses in order, and in addition to providing the most sound and accurate instrument that can be, they give due consideration to every detail which will make them acceptable to those who are influenced by appearance. There is no disgrace in making a microscope and its case ornamental as well as useful.—*Knowledge*.

Microscopical Notes.

M. J. CROSS.

For *Knowledge*.

STAINING LIVING BACILLI.—We have had placed in our hands an interesting paper by Mons. A. Certes dealing with the selective coloring power of the spore-bearing filaments of the *living Spirobacillus gigas* with methylene blue, and the following is a brief *resume* of it.

He remarks that the experiments of Brandt, Henneguy and himself, dating from 1881, prove that living protoplasm can absorb certain aniline colors, but little has been done by biologists in the study of the action of coloring substances on living microbes. It has been found that certain microbes cease to live on being stained, others absorb the stain and still remain alive, while others do not absorb the stain either alive or dead.

The difficulty of making observations on selective coloration is obvious on such delicate subjects as bacteria, but M. Certes was fortunate in discovering the *Spirobacillus gigas* in the reservoirs at Aden; the length of these is usually 150-160 mikrons, but they are occasionally found 400 mikrons long.

These organisms placed in a weak solution of methylene blue continue to move about with the same activity as before, and the stained specimens can be preserved alive until the following day if care be taken not to exclude oxygen.

The effect of the stain varies according to the stage of development of the bacilli. During the first two or three days the living specimens are entirely and uniformly stained in blue exactly like dead specimens.

When the period of sporulation commences, alongside of the totally stained bacilli, the presence of bacilli of different shapes is observed, partially stained and much more clearly. In the same specimens are colored rings in juxtaposition to uncolored rings, grouped in the most varied manner and without any apparent fixed rule.

The spore-bearing individuals which appear a little after, give the clue to these selective coloration phenomena, which acquire a still greater clearness when the specimens are larger—as the turns of the spiral are less serrated, and the spore-bearing bacilli move more slowly in zig-zig fashion. One sees, therefore, that the spores, while refractive, have, except in rare cases, absorbed the coloring matter and that the filaments which carry them are, in general, more feebly colored, some times even uncolored, and that in those specimens whose spores are localized at one extremity on a fixed point on the filament, the rings which carry the spores are almost always uncolored.

Success largely depends on the coloring re-agents that are used. The finest quality of Ehrlich's blue and the chemically pure methylene blue of Grubler and Höchst in very weak solution are recommended, and they should be used at the precise moment when the first sporule-bearing individuals appear.

These phenomena are only visible in the living state; dead specimens stain so rapidly and uniformly that it is extremely difficult to obtain preparations in which the

differentiated coloration is plainly or distinctly visible.

SUBSTAGE CONDENSERS.—It is gratifying to observe the number of first-class substage condensers that are offered by manufacturers, and it is a distinct indication of growing knowledge and appreciation of good things on the part of workers.

It was at one time an easy matter to make a choice when only two or three systems were available, but it is evidently presenting some complexity now, and in response to correspondents' enquiries we propose to give a few hints on the subject.

The main features of a condenser are: (1) *The achromatism*, (2) *aplanatism*, (3) *magnifying power*, and (4) *the size of the fixed lens*.

Achromatism and *aplanatism* can be considered together, but the latter is more important. Recognizing this, there is a tendency on the part of makers to claim greater aplanatism than is actually yielded; this can however, easily be verified by the methods described in the textbooks. Achromatism is a desirable quality but we doubt the advantage of an apochromatic over an achromatic condenser; we would as readily work with the latter as the former provided the aplanatism were as well corrected, and this is frequently the case. Expense may therefore be avoided without loss of efficiency in this respect. The solid illuminating cone that an objective will bear has been frequently discussed. It is generally stated that three-fourths the full aperture is the best, but it will be found that the majority of lenses will not bear more than two-thirds without deteriorating in performance; there are some exceptional ones that will take more than a three-quarter cone, but this is not the rule, and a light filter is usually requisite.

The Power.—The magnifying power of the condenser should not exceed half that of the objective, less rather than more than half is always preferable. Many systems

are arranged to work satisfactorily with the front lens removed, and by this means high and low power effects are secured in one combination.

Size of field lens.—The reason for the popularity of the Abbe illuminator, with its glaring imperfections, is on account of its large field lens and the ease with which it can be worked. A high power condenser must of necessity have comparatively small lenses, and requires as great care in manipulating as the objective itself. The Abbe achromatic condenser was an attempt to maintain the easy working of the Abbe illuminator in a corrected form, but it is really too heavy and clumsy and restricts the movements of a mechanical stage. The best condensers have, as a rule, the largest field lenses that can be advantageously fitted, but this point is deserving of special consideration when making a decision.

Recommendations.—From the foregoing it will be possible, with given objectives and a maker's catalogue, to choose the most suitable condensers. If a man proposes to restrict himself to low and medium powers, not exceeding say $\frac{1}{2}$ in., he can readily make a choice, and we would like to specifically mention the new condenser introduced by Mr. C. Baker, of 244, High Holborn: in this a specially large field lens is provided; the power (4-10 in.) is exactly the right one for histologists and workers with medium power objectives, while the aplanatic aperture closely approaches .90. We have found it most effective in some work we have been doing recently, and great credit is due to the maker for its introduction.

The worker who does not go beyond an aperture of 1.25 can do all that his lens will permit with a dry condenser having the nominal aperture of 1.0 and yielding an aplanatic cone of .90 as several of them do. If higher apertures are used, an oil immersion condenser is necessary. This advice has an appalling sound, but it is too little recognized that such systems can usually be worked dry, and

will then give an aplanatic cone exceeding $\cdot 90$. Such is the case with Watson & Son's holoscopic condenser. Again, the top lens can be removed and a condenser of low power secured. Oil immersion condensers are too little appreciated, and it will be found, if it is desired to work with medium and high powers, that the oil immersion system will serve every purpose and is practically a universal condenser.

ILLUMINATION WITH ARTIFICIAL LIGHT.—The lamp that has proved most universally satisfactory is the regular one sold for microscopical work, with a $\frac{1}{2}$ -inch or $\frac{3}{8}$ -inch wick, but to many people this is objectionable for several reasons, the chief of which is that with the general use of gas and electric light, a mineral oil is not kept in the house, excepting for this special lamp; it also is not clean to handle, and requires a certain amount of attention; also it is not always immediately ready for service when required. In laboratories, such a lamp is out of the question, and bare gas jets, or gas jets with upright chimneys, are generally to be found.

I have recently been making some experiments with gas and electric lamps to see if some practical form of illuminant, always available for use without special preparation, cannot be devised for critical microscopical work.

Two important considerations have to be kept in view, one is that the light must be brilliant, and the other is that it should be possible to focus an image of the source of light by means of the substage condenser, in the field of view.

A very serviceable illumination can be secured with the Welsbach incandescent gas light, but the reticulations of the mantle are an obvious objection, and the flame has too large a surface. These can be overcome by means of a shade of metal surrounding the chimney at a distance of three or four inches. In this shade, a small rectangular or circular slot should be perforated. When working,

this slot would be treated as the source of light and focussed accordingly.

At a recent meeting of the Royal Microscopical Society, Mr. Rousselet exhibited an incandescent electric lamp of the Edison and Swan "Focus" type, which has a somewhat coarse filament not unlike a corkscrew suspended horizontally in the bulb. This lamp gives an intensely brilliant light, and it has on many occasions been used for magic lantern purposes. It was recommended that the light for microscopical work should be taken from the edge of the filament and focussed in the same manner as the wick of an oil lamp. The light arranged in this way was, however, to my mind too much diffused, notwithstanding that a shade was used. On making further inquiry I find that a stand for an electric lamp is made for laryngological and aural examinations which has joints and movements for adjusting in any desired position. In the usual type it carries an ordinary eight or sixteen candle-power lamp, but it will quite well carry the "Focus" pattern. If now an enclosing shade be provided similar to that described for the Welsbach light above, with an aperture which can be treated as the source of illumination, an ideal electric light for microscopy is secured. This would answer well also for photo-micrography.

A lamp, somewhat similar to the foregoing, has been used by me with considerable satisfaction, though long usage has created a distinct prejudice in favor of the $\frac{1}{4}$ -in. wick oil lamp.

All workers have not electric current available so this will not appeal to them, but the majority have gas, and where oil lamps are objected to, I would advise a trial of the Welsbach light arranged as described above.

PHOTO-MICROGRAPHY WITH ARC LAMP.—Trouble is invariably experienced in maintaining the light in one central position, and several devices have been resorted to in order to control this. No automatic lamp is really use-

ful for the purpose. A hand-fed lamp must be employed. When this is properly adjusted and the condensing lens is in position, a luminous disc will be seen upon the leaves of the partially closed Iris diaphragm of the substage condenser. During an exposure it will only be necessary to maintain this disc in a fixed position by turning the milled head of the lamp very gently as required, and the light may be kept perfectly central for any length of time. It is presumed that a horizontal camera would be used.

STAINING FLAGELLA.—The preparation of Bacteria so as to exhibit flagella has always seemed to be unsatisfactory and difficult. Very few workers are really successful and none have produced permanent mounts. An interesting note occurs in the Thompson Yates Laboratories Report, by Dr. MacConkey, which deserves consideration.

It has been considered essential when staining such preparations to use a mordant, presumably to fix the dye in the substance of the flagellum. It is suggested that the rendering visible of the flagella in consequence of the use of the mordant is not because of the effect which it has hitherto been credited with producing, so much as by causing the flagellum to swell and become thicker. The flagella are of exquisite tenuity, so much so, that when stained, the dyes do not seem to render them visible to the same extent as when a so-called mordant is used. The suggestion put forward is confirmed by the statement that the flagella appear to be thicker than they are supposed to be actually, and the organisms themselves are larger after the use of a mordant than when stained in the ordinary way.

There are dyes which have the effect of staining the flagella deeply and producing a thickening, but it is observed that, as these colors fade, the flagella become increasingly fine until at last they are no longer visible.

This is a subject in which, to the ordinary microscopist, few opportunities are afforded of making experiments

a good service would be rendered if some really definite and permanent process, based on an understood system, could be formulated.

FINE ADJUSTMENTS.—In the details of the construction of microscopes, as in fact in every other instrument or machine, there is no real finality, and each year sees the introduction of some slight improvement which may tend to make work easier and more accurate. A study of the catalogues of the various microscope manufacturers of a year or two ago will afford food for reflection, for nearly every noted maker then expressed his unbounded confidence in his particular form of fine adjustment. One states that his "must be considered to be a triumph of mechanical skill," another "has proved absolutely satisfactory," and a third "its reliability is unsurpassed." Yet within the space of a few months nearly all the leading makers found it desirable to introduce new devices for fine adjustments. All of them have distinctive features, indicating that care and consideration have been given to their design, and it will probably prove of interest to readers to be made acquainted with such particulars as I have been able to collect from the various makers, for every new idea which enables the worker to manipulate more precisely than available means have permitted him formerly to do, should receive both consideration and commendation.

A perusal of the paper read before the Royal Microscopical Society, by Mr. E. M. Nelson, and reported in the Society's *Journal* for August, 1899, on the "Evolution of the Fine Adjustment," conveys some idea of the gradual improvement that has taken place in the movement.

Those who use a substage condenser giving a small applanatic cone will probably not feel the necessity of a better fine adjustment than that which is usually fitted to student's stands having the direct pillar action.

Directly an illuminating cone bearing a fair proportion

to the numerical aperture of the objective is used, the necessity for a slow and precise movement by fine adjustment becomes overwhelmingly apparent.

In a previous article we referred to the fact that many new substage condensers yielding large cones of illumination had been recently introduced, and as the supply of such articles must indicate a demand, it necessarily follows that the people who have used them have discovered the weakness in the fine adjustments of their instruments, have called for something better, and response is being made by manufacturers to meet this fresh demand.

There are four new fine adjustments which I propose to review, as follows:—The Continental pillar fine adjustment with levers, designed by Reichert, of Vienna; the new fine adjustment fitted to their photo-micrographic stand, by Zeiss; the "Ariston," by Swift and Sons; and Stringer's fine adjustment, by W. Watson and Sons.

REICHERT'S FINE ADJUSTMENT.—The great weakness of the Continental pillar form of fine adjustment has been consequent principally on the difficulty of producing a sufficiently slow rate of movement with a direct-acting screw that would stand wear and tear. The problem has been met by Reichert's device, which consists of a screw, having a point which engages two lever arms, the upper pressing upon the lower, and being mounted from the outer sides of the pillar. To the under sides of these levers is attached a piece of hemispherically shaped metal, which has on its curved side a point which communicates the motion. A reference to the illustration in his catalogue makes this otherwise obscure description quite clear, and it will be further seen that the rate of movement is diminished by the proportions of the lever arms, which are about $2\frac{1}{2} : 1$. This would mean that if a screw of the ordinary kind were used, the rate would be reduced to 1-250 in. for each revolution instead of 1-100 as in the old pattern.

THE MICROSCOPE AND THE PHARMACEUTICAL CHEMIST.
—To the busy medical practitioner, reference to the microscope for diagnostic purposes is a matter of every-day occurrence. Those who have not the time or disposition to do the work themselves, have at their disposal associations and laboratories which cater to their special needs. In addition to these facilities, it is becoming usual for pharmaceutical chemists to make themselves acquainted with the wants of medical men in these respects, and to be prepared to make the examinations, and to provide themselves with the necessary modern apparatus for so doing.

The microscope is becoming increasingly important in the curriculum of the pharmaceutical student, and it is in no small degree due to this profession that so many of our food and drugs that once were adulterated, are now purer and of better quality. Powdered drugs and spices were frequently mixed with starches, flour, etc., but the microscope quickly discloses such foreign materials. The knowledge of active constituents and other cell contents of medicinal plants, and their distribution in different tissues and organs is becoming increasingly comprehensive and accurate, and experiments aided by the use of special micro-chemical reagents are in progress to identify the vegetable alkaloids and related substances microscopically.

It is satisfaction to know that work of so thorough a nature is in progress, and it is a guarantee that with increased and more general expert knowledge, our food, drugs, and other commodities will be purer and finer than they have been.

THE WORKSHOPS OF E. LEITZ, WETZLAR.—A correspondent sends a description of his visit to the microscope factory of this noted optician. The following is a short resumé:—

The output of this house is 5,000 microscopes per annum, leading one almost breathlessly to ask "What becomes of

them all?" Leitz's great feature is that he confines himself entirely to microscopes and their accessories, instead of producing scientific instruments of every description as English opticians generally do. Herein lies his success.

With a large and regular demand for certain fixed models, a system of production in which machinery plays an important part is possible, and ensures sound construction with a minimum of cost. The supervising and testing departments are of the most thorough description, and when the care that is taken is known, it is not to be wondered at that the Leitz objectives are credited with being more uniform in quality than any others.

It has many times been stated that the reason why Continental houses produce cheaply is because they employ women workers. Leitz has no female labor at all; all his men are skilled mechanics, the majority of whom have been trained in the works.

It is quite possible for English houses to compete successfully with foreign competitors if they do but adopt their methods, which may be summarised in a few words. Have the works in a country town where rents are low, and the cost of living less than in a city. Have suitable buildings for workshops, and the rest is a matter of system and machinery.

THE QUEKETT MICROSCOPICAL CLUB.—The practical work done by this Society, which was founded in the year 1865, is recognized as being of the first importance.

The meetings are attended by the foremost microscopists of the day. The journal, which is published bi-annually, and gives reports of the papers read and the proceedings generally of the club, is always worthy of careful perusal, but the great characteristic feature of the club is the welcome it extends to the amateur microscopist and the means it affords for bringing the novice into touch with the sound principles of manipulation, working and collecting.

. On the first Friday in each month, a "Gossip" evening is held, at which specimens are exhibited by members and discussed conversationally, the regular business meetings of the society taking place on the third Friday in each month. There is, in addition, a first-rate library, and cabinet containing 6,000 slides, which are at the disposal of the members.

We have before hand a list of the excursions for the forth-coming season. These take place principally on Saturday afternoons, and have for their object the collecting of material that will afford interesting studies microscopically. "Pond life" has always been a very strong subject with the club. Visits are cordially invited to the meetings, which are held at 20 Hanover Square.

When it is stated that all these advantages are offered without entrance fee for the modest sum of 10s. per annum, it will be conceded that every microscopist ought to make a point of becoming a member, and so supporting, in a practical manner, a club which has in the past and will continue in the future to promote the best interests of every feature in microscopy.

RINGING SLIDES.—Many amateurs prepare and mount specimens remarkably well, but few manage to put the ring of cement on neatly. It requires practice certainly, but generally it is through using the cement in too thick a condition. Professional mounters have two bottles, one containing the cement, the other the solvent—generally turpentine or methylated spirits. The brush is first dipped in the solvent, then in the cement, and a thin coat is deposited on the slide as it is rotated on the turntable. Some build the ring up at once, others allow the first layer to dry and then complete the process: if there is sufficient time available the latter is the better way, but each time a fresh brushful of cement is taken, it should be preceded by a dip in the solvent. The cement can then be deposited with cleanness and regularity.—*Knowledge*.

BIOLOGICAL NOTES.

L. H. PAMMEL.

STUDIES IN CYPERACEÆ.—Mr. Theo. Holm, well-known for his studies in vegetable anatomy, has issued another paper upon the above topic. Before taking up the anatomy of *Vignæ* (*astrostachyæ*) he discusses briefly some of the main facts brought out in his studies of other species in which the following important facts are brought out with reference to the Utriculus. "If it were not that this organ possesses such excellent morphological characters, by which our species of *Astrostachyæ* may be readily distinguished from each other, one would naturally suppose that the number of the species were much smaller, by examining the anatomical structure. The fact is, when we examine the structure of utricle, we do not find any points of importance by which these species may be distinguished anatomically. The differences are so slight and seem merely to depend upon a relative broader or narrower mesophyll and a larger or smaller number of isolated stereome-bundles, that none of these may be considered as being neither constant nor of sufficient importance to be used as anatomical characters. When we finally compare the morphological and anatomical characters with each other, it seems as if our species may be naturally classified as representing a section of *Vignæ*. The transition from the "hebetatæ" to the "centrales" seems very gradual and as we have shown in the preceding, none of these species possess characters that stand as isolated among the others, either in morphological or anatomical respects. The drawings, as usual, are excellent. (*Am. Jour. Sci.* 11: 205, 1901.)

THE HAUSTORIA OF VARIOUS ERYSIPIHÆ.—G. Smith discusses the anatomical and structural characters of the Haustoria with several species of this family. The haustorium contains a nucleus? The nucleus of the host plant

is more or less disorganized, the outer wall of epidermal cells becomes thickened and forms a centripetal ingrowing membranous body, which the pedicel of the haustoria must push inward. After this growth into the cavity of the cell, the haustoria is surrounded by a sheath which consists of the plasma membrane of the host plant, and unchanged cellulose. (Bot. Gaz. 29: 153.)

CENTROSOMES.—The subject of centrosomes finds a further exemplification and confirmation by S. Yamanouchi. He was unable to find the centrosomes in the resting nuclei of the pollen mother cells of *Lilium longiflorum* but it was possible to find them in the first stages of the division of the cell. He frequently found the centrosomes either on one or both poles. The material was fixed with Flemming's solution, washed with water, 70 per cent of absolute alcohol and chloroform, and imbedded in paraffine. Materials were stained with Bohmer's Hæmatoxylin and Flemming's orange method. (Beihefte Bot. Centralblatt, 10: 301. 1 pl.)

ARE THERE BACTERIAL DISEASES OF PLANTS?—Dr. Erwin F. Smith has just distributed separates of his four papers on the above topic published in the Centralblatt f. Bakt. Parasit. u. Infekt. The papers are of unusual excellence, showing the normal pathological conditions of the plants affected by various organisms, the figures being made from photographs. Dr. Smith discusses the evidences pro and con of the various diseases investigated by himself with some of the collateral work carried on by other investigators. Dr. Smith is well-known for his careful investigations along the line of pathology and his many experiments leave no question of the diseases discussed by him being caused by micro-organisms. It is strange that so noted an authority as Fischer should doubt that there are any bacterial diseases of plants when these facts are well recognized by most plant pathologists.

ACTION OF HYDROCYANIC ACID ON SEEDS.—Mr. C. O. Townsend in a paper on the effect of hydrocyanic acid gas upon grains and other seeds, concludes that dry seeds may be fumigated with the usual strength of the gas for the length of time required for the infection of animal life, without in any way interfering with the germ power of the seed. Dry seed may be subjected for several months to the influence of hydrocyanic acid gas at the rate of a gram or less of KCN per cubic foot without entirely destroying the ability of the seed to germinate. Seeds soaked twenty-four hours or more will not germinate in a gas stronger than 0.003 gm. of potassium cyanide per cubic foot. Seeds soaked thirty-six hours will germinate more readily than when soaked only twenty-four hours, but will not germinate in a stronger atmosphere of hydrocyanic gas than 0.0003 gm. of potassium cyanide per cubic foot. (Bot. Gaz. 31 : 241.)—L. H. PAMMEL.

Notes on Microscopy.

F. SHILLINGTON SCALES, F.R.M.S.

INSTANTANEOUS PHOTOMICROGRAPHY.—Mr. A. C. Scott, has devised an arrangement by which he has been able to obtain instantaneous photographs of microscopic living organisms. A powerful light is, of course, necessary, and in his own work he has used an arc light of 2,200 volts, giving about 4,000 candle-power. This light is placed at a distance slightly greater than the focal length of the condensing lens to obviate such concentration of heat as would be detrimental to the microscope objective. The camera is of the usual vertical type, but the important essential is a combined shutter and view-tube, which is clamped by means of three thumb-screws to the draw-tube of the microscope; this apparatus is fastened above the ocular, and after the latter has been inserted in the draw-tube. The mechanism of this apparatus is describ-

ed as follows: "Upon a movable brass plate inside a light-tight box is a 99° prism, mounted in such a way that all the light which passes through the microscope is projected upon a piece of ground glass at the end of a cone, which may be lengthened or shortened in order to give correct focus to the object, when it is properly focussed upon the ground glass of the camera directly above the microscope. Next to the prism is a hole in the brass plate for allowing light to pass from the microscope directly to the photographic plate, when the prism is moved by a spring and pneumatic release, and finally a sufficient area of the brass plate to cover the opening when exposure has been made. To take a photograph, the microscopic animal is placed in a drop of water upon a suitable glass plate, the light is turned on and the shutter so set that the object may be focussed upon the ground glass of the cone. The plate-holder is inserted and the dark slide drawn, leaving the plate exposed inside the camera bellows. The movements of the animals are easily seen upon the ground glass, and when the desired position is obtained the shutter is released, the prism moves out of the way and the light passes to the plate." The apparatus is not yet perfected to its inventor's complete satisfaction but he states that exposures as short as one fortieth of a second have been very satisfactory, and considers that thoroughly satisfactory negatives can be obtained with low-power objectives in one-hundredth of a second. The magnification has, however, ranged up to 200 diameters. Mr. Charles Baker, of High Holborn, in his last catalogue, mentions a somewhat similar arrangement for instantaneous photomicrography in which a pneumatic shutter with a prism attachment enables the object to be viewed on a ground-glass screen at right angles to the optic axis up to the moment of exposure. Mr. Andrew Pringle, in his well-known book on practical photomicrography, describes a vertical camera for the same purpose,

but of different construction. This camera is fitted with a pair of "goggles" and a velvet bag for the head. An instantaneous shutter, made of thin sheet aluminium, lies almost in the plane of the sensitive plate and bears white discs upon which the focussing is done, and the image is watched until the time for exposure.—*Sci. Gossip*.

MICROSCOPICAL MANIPULATION.

BLEACHING BONE.—Place articles in a glass vessel with oil of turpentine, expose to sun for three or four days, a little longer in the shade. Turpentine acts as oxidizing agent, forms acid liquor, which sinks to bottom of vessel, and strongly attacks bones if allowed to touch it. To prevent this they should rest upon strips of zinc, so as to be a fraction of an inch above bottom of vessel. It also applies to ivory and woods of various kinds. Prepare solution of fresh chloride lime 1, water 4. Put bones in this and allow to remain for a few days. Then take out, wash, and dry in open air. Place in mixture of unslaked lime, bran and water, boil until free from fatty substances, and are white. Pour oil of turpentine over them in tin box, which can be hermetically closed, let remain for ten hours, remove, and boil for three hours in soft-soap water. Skim off impurities, cool hot water with cold, dry bones on pine boards in open air, protected from the sun.—*Eng. Mech.*

COLORING MATTER OF ALGÆ.—R. Kolkwitz (Chem. Centralblatt), says the color of the cyanophyceæ, which are so abundant in the effluent of sugar works, and are met with both in fresh and salt water, is due to the presence in the plants of a fine indigo-blue water-soluble coloring matter, phykocyanin, as well as chlorophyll. It may be obtained in a crystalline state by treatment with ammonium sulphate, in the same manner as albuminoids may be precipitated. It is improbable that this body exercises any toxic effect upon fish; the harm caused to them he

attributed to the presence of putrid algæ in the water.

BACTERIOLOGY.

WIDAL'S REACTION IN TYPHOID FEVER.—The typhoid culture must be in a suitable condition; this is best effected by making the stock culture on agar agar, and keeping it at 37 deg. C.; and this must be renewed once a month. When the test is to be applied, a loopful of the culture on the agar is planted in a tube of sterilized bouillon and placed in the incubator for eighteen hours. At the end of that time a drop is examined under the microscope, to see whether the bacilli are active and that no clumping is present.

The serum should be carefully diluted at least one in twenty before the culture is brought into contact with it. If the reaction is obtained with serum of this strength you may be sure that ninety-nine times out of a hundred the serum has been obtained from a patient who has been attacked with enteric fever. The 1 per cent is allowed for errors in technique, and also because it has been reported at serum obtained from cases of abdominal typhus has given the reaction. It is a question whether these causes are not a mixed infection of typhoid bacilli, with some other organisms.

BACTERIOLOGY.—Dr. W. C. Mitchell is professor of microscopy in Denver Medical College. The laboratory work consists in the use of culture media and staining reagents; cultivation and staining of pathogenic organisms; clinical methods of detecting tubercle bacilli in sputum, urine, etc.; method of detecting the bacillus of diphtheria; bacteriological examination of water, ice, milk, etc.

PRESERVATION OF EGGS.—Dr. N. Hanika (Landwirth, Woch. f. Bayern) says that he has found in the pores of even newly-laid eggs, micro-organisms which cause decomposition; and that it is evident from this that meth-

ods of preservation which aim only at the exclusion of the atmosphere must consequently be useless. He proposes in place of the various processes now in use the following novel one which he says attains the desired end completely. The eggs to be preserved, which should be as fresh as possible, must be examined closely, by tapping and otherwise, to guard against cracks or breaks in the shell. They are then laid in water of about 95° F. for about fifteen minutes, or until they are well warmed throughout. Every particle of dirt should be removed from the shells by wiping with a sponge wet with warm water. The eggs are then put, in suitable quantities, in a sieve, net, or loosely woven basket, held for five seconds in boiling water and removed thence as quickly as possible, into cold water. The eggs, still wet, are laid on a clean linen cloth and let dry off spontaneously by exposure to the atmosphere. Under no circumstances should they be dried off with a cloth or towel. As soon as they are quite dry they are packed in a box with either ground peat, sifted wood ashes, wheat chaff, wood-wool, or wheat bran, the packing material to be made thoroughly dry by heating before using. The five-second dip in boiling water was sufficient not merely to kill the microbes in the shell substance and between it and the inner skin, but to cause the coagulation of a thin but all-sufficient layer of albumin lying next the skin, and thus form an impassable barrier to the exit of water and entrance of air, with its microbes.

MICROSCOPIC INSPECTION OF PORK.—The number of carcasses examined in 1900 was 999,554, resulting in the following classification: Class A, free from all appearance of trichinæ, 968,405, or 96.88 per cent; Class B, containing trichina-like bodies or disintegrating trichinæ, 11,701, or 1.17 per cent; Class C, containing living trichinæ, 19,448, or 1.95 per cent. The number of certificates issued for 253,333 inspected packages was 12,107; covering a weight of 55,809,626, pounds. There was a great falling

off in the trade in microscopically inspected pork products. The cost of this work was \$154,950.22; average per carcass, 15.5 cents; per pound exported, 0.277 cent. For 1899 the cost was \$198,355.14.

INTERNATIONAL ASSOCIATION OF BOTANISTES.

Several leading botanists of different countries being convinced, that a better organization would contribute in a most desirable manner to the mutual aim viz. the progress of botany, have the honor to invite you to become a member of a new Society to be called the *International Botanical Association*. A general meeting will take place at Geneva (Switzerland), on the 7th of August next in the botanical laboratory of the University at 10 a. m. During this meeting several questions will be submitted to the judgement of the members and you are invited to propose orally or in writing such measures as you think it desirable that the new Society should adopt. The chief object of the Association will be the foundation of a bibliographic periodical criticising in a perfectly impartial manner all botanical publications. The criticisms will—at the desire of the contributors be published in English French or German. All will be submitted to the judgement of an editor nominated by the Association and responsible to it.

It is most desirable that the membership be as wide as possible, since this is the only way of making membership inexpensive. Under no circumstances the membership will cost more than \$6.00, including the gratis delivery of the periodical. Another great advantage of the new Society is that by its means members who live in different parts of the globe will be brought into more intimate contact one with another and this will greatly facilitate the procuring of material for investigation and demonstration. Application for membership should be sent to: Dr. I. P. Lotsy, Wageningen, Holland.

EIGHTH EDITION. JUST READY

Carpenter



on the **Microscope**

and its **Revelations**

Edited by W. H. Dallinger, D.Sc., D.C.L., F.R.S.

With 25 Plates and nearly 900 Engravings

Octavo. 1181 Pages. Cloth, net, \$8.00; Half Morocco, net, \$9.00

****Eight of the chapters have been entirely rewritten and the text throughout reconstructed, enlarged, and revised with the aid and advice of E. M. Nelson, ex-President of The Royal Microscopical Society; Arthur Bolles Lee, author of "The Microtomist's Vade Mecum"; Dr. E. Crookshank, the well-known Bacteriologist; Prof. T. Bonney, F.R.S.; W. J. Pope, F.I.C., F.C.S., etc., Chemist to the Goldsmith's Technical Institute; Prof. A. W. Bennett, Lecturer on Botany at St. Thomas' Hospital; and F. Jeffrey Bell, Professor of Comparative Anatomy and Zoology, King's College, London.**

"CARPENTER" is the only complete and exhaustive modern work on the Science of Microscopy.

Send Orders to

Chas. W. Smiley

Washington, D. C.

ANNOUNCEMENT

Carpenter on The Microscope

EIGHTH EDITION

THE use of the Microscope, both as an instrument of scientific research and as a means of affording pleasure and recreative instruction, has become so widespread, and the instrument is now so frequently found in a form capable of yielding in skilled hands good optical results, that it is eminently desirable that a treatise should be within the reach of the student and the tyro alike which would provide both with the elements and the theory and principles involved in the construction of the instrument itself, the nature of the latest appliances, and the proper conditions on which they can be employed with the best results. Beyond this it should provide an outline of the latest and best modes of preparing, examining, and mounting objects, and glance, with this purpose in view, at what is easily accessible for the requirements of the student in the entire organic and inorganic kingdoms. This need has been for many years met by this book, and the large sale of its seven preceding editions has been an extremely gratifying evidence of the industry and erudition of its author and of its usefulness as a working guide. From the beginning it opened the right path, and afforded excellent aid to the earnest amateur and careful student.

The advances in the mathematical optics involved in the construction of the most perfect form of the present Microscope have been very rapid during the last few years ; and the progress in the principles of practical construction and the application of theory have, even since the last edition of this book was published, been so marked as to necessitate the rewriting of much of the text.

In its present form, therefore, a treatise of this sort, preserving the original idea of its author and ranging from the theory and construction of the Microscope and its essential apparatus, embracing a discussion of all their principal forms and the right use of each, and passing to a consideration of the best methods of preparation and mounting of objects,

THE AMERICAN

MONTHLY

MICROSCOPICAL JOURNAL.

Entered at the post-office as second-class matter.

VOL. XXII.

JULY, 1901.

NO. 7.

CONTENTS.

The Viability of the Bacillus Pestis. Rosenau.....	181-188
Work on Ciliate Infusoria. Stevens.....	188-191
The Preparation of Crystals as Microscopic Objects. Dowdy....	192-195
NOTES BY SHILLINGTON SCALES.—Stridulating Organs in Beetles; U. S. Rotaoria; Scales of Fishes.....	195-199
A Microscope Proof of the Food of Primitive Man. White....	199-201
MICROSCOPICAL MANIPULATION.—Distinguishing Human and Animal Blood; Cement to Stand Spirits.....	202-204
BACTERIOLOGY.—Variability of T. bacillus; Sputum and Urine; Milk dirt; Action of Cold on Bacteria.....	204-206
BIOLOGICAL NOTES.—Atoms; Micro-organisms in Coal Beds; Red Rain.....	206-207
MICROSCOPICAL SOCIETIES.—Quekett.....	207-208
NEW PUBLICATIONS.—Microscopy of Starches; Mosses with a Hand-lens; Astrology; Sea-weeds.....	208-210

The Viability of the Bacillus Pestis.

M. J. ROSENAU.

We now know that this organism may live for months, and even years, in a test tube, on a moist albuminous medium. And the present work shows that even when dry it may live over four months, provided the temperature is cool—less than 20° C. The bacillus of plague can in no sense be considered a tender organism, as was at first supposed. It is much easier to cultivate than the lanceolate coccus of pneumonia or the pathogenic streptococci. In this respect it resembles more closely the hardier of the hemorrhagic septicæmic group.

We tested the life history of this organism upon a great variety of objects and under various conditions. We

attempted to imitate nature. But we can not imitate all the conditions under which the organism may exist in nature, and we ought not, therefore, to apply the experience of the laboratory too literally to the life history of the plague bacillus outside of the body. We may determine with fair certainty the length of time the bacillus may live under given conditions. But these conditions are more or less arbitrary, and to a certain extent artificial. In general terms, we can state whether it is a hardy organism, resistant to influences usually detrimental to bacterial life, or one that loses its virulence and dies quickly when removed from its natural habitat. The bacillus of plague does not exist in nature on sterile glass-cover slips, nor yet in the desiccator over concentrated sulphuric acid, which were conditions used by some authors who have reported their results on this question.

The test objects were very abundantly inoculated with a pure culture of the bacillus pestis of known activity and virulence. Often the test objects were saturated. The cultures had been grown for a long time upon artificial media in the laboratory, so that their vitality was probably strongly influenced. It is a well-known fact that virulent pathogenic bacteria may at first grow very poorly upon the ordinary laboratory media, but by successive cultivation they become accustomed to the new conditions, so that they finally thrive abundantly ; that is to say, they take on a sort of saprophytic existence. Such cultures would doubtless resist the various influences to which they are exposed in the laboratory tests better than another race direct from the blood or tissues. In fact, it is found that the plague bacillus in the blood and tissues from a rabbit usually dies out rather quickly when dried upon the test objects. On the contrary, bouillon cultures dried on similar objects and under similar conditions live a much longer time.

Another departure from normal conditions was the fact

that all the test objects receiving the abundant inoculations of the virulent pure cultures were sterile. In other words, not only were cultures of the bacillus used that were accustomed to a saprophytic existence, but these cultures were placed upon sterile test objects and protected against contamination, so that they were relieved from that microbial symbiosis which, in the economy of nature, plays so important a part in the suppression of pathogenic micro-organisms. It is known that in organic mixtures the hardier saprophytes tend to overpower the *bacillus pestis*.

PLAGUE AND FOOD.—Our experiments show that food products may harbor the infective principle of plague, but according to experience food products are not much to be feared as far as their probability of carrying the infection is concerned. This latter statement does not apply to milk and its products, for milk is a good culture medium for the *bacillus pestis*; and we kept it alive seventeen days in cheese and seventy-two days in butter. On the surface of food products it usually died very quickly. It did not live twenty-four hours on orange peel. We had similar results with figs and raisins and a large quantity of Chinese food products, such as smoked and dried ducks, dried oysters, dried cuttle fish, dried ducks' gizzards, ducks' gizzards dried and placed in oil, smoked and dried pork, and duck eggs preserved in a mixture of mud and rice chaff, all of which were infected with the *bacillus pestis* and kept at 37° C. In rice we found it alive eighteen days after inoculating.

These results correspond with all our other experiments, which plainly prove that the *bacillus* cannot live long on the surface of objects, when dry, at temperatures above 30° C. In one case we kept it alive one hundred and sixteen days, and in another ninety-six days, in water preserved at low temperatures, 17° to 19° C. Under the same conditions the organism lived only six days at 37° C.

TEMPERATURE.—The effect of temperature upon the bacillus pestis is very remarkable. It may be kept alive and virulent a very long time in the cold, even though dry, but it cannot live long when dry at the temperature of the body. High temperatures, such as 70° C. or more, are invariably fatal in a few minutes. It was this that led some of the early workers to conclude that they were dealing with a frail organism. It is frail when dried at 37° C., but may live for months in the cold. We have never been able to keep it alive more than a few days when dry at 37° C.—three days in flannel, two days in sponge. On the contrary we had little difficulty in keeping it alive on a variety of objects three and four months at 17° to 19° C. The bacillus is not as sensitive to temperature when kept moist, for under such conditions it will live a very long time in albuminous media at 37° C. From the experimental studies with the plague bacillus we would infer that the endemic foci of plague should be in cold climates.

Moisture is a definite factor in the viability of the bacillus pestis. The organism must have moisture to grow, and it may remain alive and virulent a very long time in the presence of moisture. It usually dies quickly when dry. However, this is not invariably the case. We have been able to keep it alive in media such as dried albumin for one hundred and twenty-five days, when it was still virulent for mice. But to keep it alive when dry the organism must be cold, i. e., exposed to a temperature less than 20° C. In no instance could the organism be kept alive when dry at a temperature of 37° C. for more than a few days. ●

Our experiments confirm those of other workers in this field, who find that for the most part the bacillus pestis soon dies when exposed to bright sunlight. Our work leads us to the conclusion that the heat as well as the sunlight plays an important role; also that the effects of the

sunlight do not penetrate very deeply. It is therefore safe to say that objects may be efficiently disinfected on the surface by exposing them all day to a bright sun, provided the temperature in the sun is above 30° C. The plague bacillus was kept alive a long time in moist garden earth, especially when kept cool. It dies very quickly in dry earth. We were not able to keep it alive longer than twenty-four hours at any temperature in dry earth. As moist earth will preserve the life of the bacillus it is easy to understand how the infection may live in dirty dwellings. It requires no stretch of the imagination to understand how the infection may be conveyed by the dirt and dust of moist, sunless habitations.

We have not succeeded in keeping plague alive very long when dried upon the surface of objects; even on plush, carpet, paper, wood, sawdust, bone, etc., it usually dies within a few days. In porous substances such as sponge we found it alive after one hundred and twenty-five days, when allowed to dry, at 19° C. Here again temperature plays an important role, for at 37° C., all the other conditions being the same, it lived only two days.

A bacillus of plague lives long in albuminous matter. Clothing and bedding are especially apt to be contaminated with the discharges from buboes and blisters, sputum, etc. Articles so infected and kept in a cool, moist place could retain the active infective principle a very long time. Clothing and bedding may harbor the bacillus of plague for months. In one instance we kept it alive on a piece of crash ninety-seven days; in albumin gelatine balls one hundred and twenty-five days; in sponge, also, one hundred and twenty-five days; in wool fifty-two days.

According to our results the plague bacillus cannot live long in letter mail. In seven tests made with cultures of the organism on paper we found that it usually died within twenty-four hours. At most it kept alive eight days

on paper allowed to dry, and fourteen days on paper kept in a moist atmosphere. To live this long it must be kept cool, for, just as in all our other experiments, it died very quickly when dried at the body temperature. We had similar experiences with plague blood upon paper.

The bacillus pestis often loses its virulence before it dies. In many of our experiments we found that the time came when the organism grew in bouillon, but lost its pathogenity for animals. This is an important fact from an epidemiologic standpoint, for an attenuated plague bacillus is probably harmless to man, even though its virulence be increased by artificial means in the laboratory.

The experiments conducted in this laboratory plainly prove that either sulphur dioxide, when moist, or formaldehyde will kill the bacillus pestis when applied in the strength and methods usually employed for these gases as disinfecting agents. In order to be effective there must be directed contact between the gas and the germ. In other words, these gaseous disinfectants can only be depended upon as surface disinfectants.

As far as practical disinfection for plague is concerned, it may be mentioned here that sulphur dioxide is probably a much more useful agent for use of ships, stores, houses, and dwellings infested with vermin, because it is destructive to the higher forms of animal life, whereas formaldehyde fails to kill mammals and insects with the same certainty that it kills microbes. In combating plague it is very important to kill fleas, rats, mice, and other forms of animal life capable of carrying the infection. Sulphur has this power, which formaldehyde totally lacks. A great number of tables exhibit details of experiments which cannot be reported here.

CONCLUSIONS.

- 1 The bacillus pestis is not a frail organism. It resembles the hemorrhagic septicæmic group or the coccobacilli as far as its viability is concerned.

2 Temperature is the most important factor in the viability of the plague bacillus. It keeps alive in the cold, under 19° C., a very long time. It dies quickly, especially when dried, at the body temperature, 37° C.

3 Moisture favors the life of the bacillus pestis. It usually dies in a few days when dry, even in the presence of albuminous matter, provided the temperature is above 30° C. It may keep alive and virulent when dry for months in the cold, under 19° C.

4 Sunlight kills the organism within a few hours, provided the sun shines directly upon the organism and the temperature in the sun is over 30° C. The effect of sunlight is not very penetrating.

5 The virulence of the bacillus pestis is often lost before its vegetability.

6 It is unlikely that new dry merchandise would carry the infection. The organism usually dies in a few days on the surface of objects such as wood, sawdust, bone, etc.

7 Clothing and bedding can harbor the infection for a long time and may act as fomites. The bacillus lives for months when dry in albuminous media at temperatures under 20° C.

8 Food products may carry the infection of plague. The bacillus lives a long time in milk, cheese, and butter. It usually dies quickly on the surface of fruits and prepared food.

9 The organism may live a long time in water, although plague is not a water-borne disease.

10 The plague bacillus does not live long on paper, and first-class mail is therefore not apt to convey the infection.

11 The colder the climate the greater the danger of conveying the infection on fomites—clothing, bedding, food, merchandise, etc.—and more extensive disinfection is required in such a climate in combating the disease than in tropical regions.

12 The plague bacillus is destroyed by sulphur fumigation and by formaldehyde gas in the strengths in which these disinfectants are usually employed. The gases can only be depended upon as surface disinfectants. In disinfecting ships, warehouses, dwellings, and other places infested with rats, fleas, and vermin, sulphur is better than formaldehyde, because formaldehyde gas fails to kill the higher forms of animal life.

13 A temperature of 70° C. continued a short time is invariably fatal for the plague bacillus. The ordinary antiseptics are all efficacious in their usual strength for non-spore-bearing organisms. Efficient surface disinfection may be accomplished by exposing objects all day to the direct sunshine on warm days. The temperature in the sun must be above 30° C.

Work on Ciliate Infusoria.

In a recent bulletin of the California Academy of Sciences, N. M. Stevens has described two new Infusorial forms. During his studies he worked on them microscopically and writes, in part, as follows :

Technique.—The respiratory tree was removed from the living holothurian, plunged into the fixing fluid, and later washed, and hardened in alcohol. Small pieces were imbedded in paraffine in the usual way, and sections 5 to 7 microns thick were cut and mounted in series. For *in toto* preparations, portions of the respiratory tree were stained, washed, and run into glycerine or through alcohols, followed by clove oil, teased upon the slide to free the infusoria from the respiratory membrane, and mounted in glycerine, glycerine jelly, or balsam.

A large number of fixing agents were tried : picro-acetic, picro-sublimate-acetic, Gilson's fluid, sublimate-acetic, iridium chloride-acetic, Flemming's strong and weak solutions, Vom Rath's solution, platinum chloride-acetic, Hermann's fluid, absolute alcohol, absolute-acetic, palla-

dium chloride, Rabl's fluid, bichromate-osmic, and osmic vapor.

Hermann's fluid gave the best results, though sublimate-acetic, absolute-acetic, Boveri's picro-acetic, Flemming's and Vom Rath's solutions proved quite satisfactory, and osmic vapor was especially valuable for temporary *in toto* preparations in the study of division stages.

Peptone and pepsin solutions, bichromate of potash (one to three per cent), formalin (one-tenth to one per cent) and fresh water were employed as macerating agents; of these, potassium bichromate (two per cent) was found to be of greatest value in revealing and isolating in internal fibre structures of *Licnophora*.

The principal stains used were Delafield's hæmatoxylin, dahlia, bismark brown, thionin, methylen blue, acid fuchsin, borax carmine, alum carmine, picro-carmine, Mayer's paracarmine, light green, safranin, Heidenhain's iron-hæmatoxylin, rubin, and ruthenium red. For fresh material picro-carmine and alum carmine gave the best results; borax carmine, paracarmine, light green, and safranin were useful in the study of fixed material *in toto*; for sections no other stain was at all comparable to Heidenhain's iron-hæmatoxylin following Hermann's fixing fluid, and used either alone or in combination with rubin or with ruthenium red.

Structure and General Biology.—*Licnophora* like most of the Ciliata has a delicate structureless pellicula not distinguishable in life, but readily separated from the cytoplasm by macerating fluids and by many fixing agents. The ectoplasm is clearly marked only at the margin of the attachment disc, between its cuticula and fibre layers, and within the triangular basal portion of the oral band where it is either homogeneous or very finely granular. The entoplasm is coarsely alveolar in both discs and more finely alveolar in the neck.

Oral Disc.—The oral disc is irregularly circular in out-

line, having a projection on the left side opposite the buccal cavity. The ventral side is depressed centrally and posteriorly, the dorsal side convex laterally and posteriorly, but continuous with the neck anteriorly. The width of the disc varies from 33.5 micron to 57 microns in fixed material, and was 72 microns in the large living specimen cited above.

The oral ciliary band begins just above the pharynx on the left side, curves about the posterior extremity and right side, and passes with a twist under the upper lip of the mouth, where it broadens out and covers the roof of the pharynx into which its cilia descend. The band is made up of about one hundred and twenty-five transverse rows of fine long cilia which are usually twisted together in action so as to appear under low power as so many stout membranellæ, but under Abbé homogeneous apochromatic oil immersion 1.5 mm., oc. 8, the individual cilia are plainly seen in the living specimen, hundreds of them in each row forming a flat brush or a stout twist. The transverse width of these flat brushes, i. e., the width of the band, is least at the beginning of the band and is increased one-half or more in the pharynx, the average width outside of the mouth being 10 microns in large living specimens. The cilia of the several rows on the left side are most often seen untwisted in the living animal at rest; while those on the right side, where the band turns toward the mouth, are often divided, one portion extending outward, the other curving toward or into the mouth.

In sections fixed in Hermann's or Flemming's fluid and stained with Heidenhain's iron-hæmatoxylin, the oral band is seen to have a complicated internal structure. At the base of each row of cilia is a deeply stained basal band whose ends are connected by fine fibres with an internal, deeply staining fibre. A cross-section of the band presents a triangular appearance with deeply stained basal

band and lateral fibres enclosing a dense homogeneous or finely granular portion. The proportions of the triangle vary greatly from the beginning of the band to its end in the pharynx.

Tracing these fibres back from the mouth-region around the peristome into the neck, their origin is found in a stout, longitudinally striated, deeply staining fibre, which arises from a branching base at the center of the attachment disc and extends diagonally through the neck to the beginning of the oral band, where it gives off a branch to each end of each basal band. The first branches given off are coarse and oblique, the later ones fine and nearly perpendicular to the basal fibre.

This stout neck fibre with its oral prolongation and branches is somewhat anisotropic, fibrous, and contractile. The only clearly differentiating stain found for it is iron-hæmatoxylin; second to this was Mayer's picro-carmin, the material being left in the stain for forty-eight hours. In macerations, the fibre with its various branches is the most resistant part of the body. Potassium bichromate (one to three per cent) will in a few seconds, aided by slight tapping on the cover-glass, dissolve away the alveolar entoplasm and the pellicula, leaving the inner layers of the attachment disc with cilia, the neck fibres and the oral band with cilia, the skeleton of the animal. Similar results were attained with pepsin and peptone solutions, one-tenth per cent formalin, and even with fresh water. The neck fibre is faintly visible in life, and is plainly seen in any macerating or fixing fluid before the cilia of the attachment disc and pharynx cease to vibrate. These facts clearly demonstrate that the fibre and its divisions so plainly shown in iron-hæmatoxylin stained sections are not artifacts.

PERSONAL.—E. G. Eberle of Dallas, Texas, is President of the Texas State Pharmaceutical Association for 1902.

The Preparation of Crystals as Microscopic Objects.

S. E. DOWDY.

Few microscopic objects are more beautiful and instructive than the crystals of various chemicals, prepared in such a way as to be suitable for viewing under the microscope. Most chemists possess a microscope, often a relic of student days, in which owing to a dearth of fresh slides, they take no further interest. The obvious remedy for this state of affairs is either to purchase more objects or to prepare some on one's own account. Where possible, the latter is much the better course to adopt, as good home-made slides are far cheaper, more typical, and instructive than bought ones. These few notes will, I trust, serve as a rough guide to the *modus operandi* to be observed in preparing this class of objects. The materials are to hand in every pharmacy, the other items required to ensure success, viz., knowledge of the solubilities of the various chemicals under trial and a certain amount of patience, should also be to hand. The other essential requisites are a few thin 3 by 1 inch clear glass slips, some medium thickness round cover glasses, a small quantity of Canada balsam dissolved in xylol, test-tubes, spirit lamp, glass stirring rod, and a small pipette.

Before starting work it is necessary to get the slips and cover-glasses perfectly clean and free from grease. That can be easily done by washing them with ammonia, rinsing with distilled water, drying them on a clean cotton rag, and finally polishing them on a piece of chamois leather. When these are ready, one of the three following methods can be adopted to prepare the slide. The first consists of evaporating down a saturated solution of the salt until enough moisture has been driven off to enable the crystals to rapidly form on cooling. The practical application of the process is as follows: Make a saturated solution of the salt in distilled water and deposit

a drop with the pipette in the centre of a 3 by 1 inch slip; slope the slide to make the liquid spread in a film, then absorb the superfluous moisture from the side of the slip with blotting paper. Now hold the slide wet side up over the flame of a Bunsen or spirit lamp, at such a distance that the liquid just steams. Continue this until you see a thin film of the salt form at the edges, then withdraw, allow to cool, and examine under the microscope. If satisfactory, the crystals can then be permanently mounted by depositing a drop of the cold xylol balsam over the film and covering with a clean cover-glass.

When the salt is insoluble in water, any suitable solvent such as alcohol, chloroform, etc., may be employed; in this case, of course, evaporation will take place rapidly without the aid of heat. Crystals formed from such solutions will probably require a different mounting medium, such as castor oil, or one in which they are not soluble. A method recommended by Dr. Lankester is to dissolve a little gelatin or gum acacia in distilled water and to add to this a few drops of a saturated aqueous solution of the salt. A drop of the warm mixture is then deposited on a slip, superfluous moisture drained off, and the slide is put on one side to cool. With some salts—copper sulphate, iron sulphate, etc.—remarkably beautiful crystalline forms make their appearance, frequently in the form of flowers and fern-like branches. Epsom salts, chlorate of potash, bichromate of potash, and, in fact, any salt soluble in water will lend itself for preparation by the above process.

The second principal method is by fusion. Its application is necessarily more restricted than the foregoing, but by its means some very effective slides may be prepared. The process is equally simple, but the results attained will not be so uniformly successful. A good substance to experiment with is salicine. Place a small quantity on the centre of a thin slip and heat it over a flame until it just

fuses, withdraw it from the heat before it chars, and allow it to cool gradually. If successful, small circular plates or rosettes will appear on the film, and these may be mounted in the usual way in cold xylol balsam. A good slide of this description, viewed with dark ground illumination, or by polarised light, will fully repay any trouble involved in preparing it. This method is useful in enabling one to prepare totally different physical forms from the same salt. With salicine, for instance, an aqueous solution deposits needle-shaped crystals, quite distinct from the circular form obtained by fusion. A point to be observed in using the process is to avoid having too much of the salt on the slip, as on cooling, the film, if too thick, will probably star and crack. If the film should be too thick for viewing as a transparent object, it will often make a good opaque one by pasting a circle of black paper on the under side of the slide.

Another class of objects, prepared in a similar way, are crystals of fatty substances, spermaceti, hard paraffin, etc. It is only necessary to place a small piece on a slip and warm it. When melted press down on it a cover-glass, the crystal forming as the mass cools. These slides cannot compare from an artistic point of view with those obtained from salts, but are interesting from the fact that the actual formation of the crystals can be watched under the microscope any number of times by simply warming the slide before viewing it.

The third principal method is still more limited in application, being confined to those substances which are easily volatilized and crystalize on cooling. Preparation of slides by sublimation may be carried out as follows. Take a dry narrow test-tube and place in it any suitable chemical—benzoic acid, for instance. Hold the tube over the flame until the acid volatilizes, now invert the tube and stand it on a cold 3x1 in. slip. The characteristic crystals will form on the part of the slip covered by the

tube, and, if satisfactory, can be mounted in the usual way. Camphor, arsenic, and many others will suggest themselves as suitable for preparing slides in this way.

The three methods described will practically cover the whole ground of preparing crystals for the microscope, and with the expenditure of a little time and patience will enable anyone to materially increase, at a nominal cost, his collection of slides. If mounted in a suitable medium, and preserved from undue heat and light, these slides will be permanent; any change which may take place in the forms of the crystals may be put down to the solvent action on them of an unsuitable medium.—*Pharmaceutical Journal*.

Notes on Microscopy.

F. SHILLINGTON SCALES, F.R.M.S.

STRIDULATING ORGANS IN BEETLES.—C. J. Gahan in "Trans. Entom. Soc." London, 1900, pp. 433-52, comments upon Schrodte's discovery of well-developed stridulating organs in the larvæ of several genera of beetles, and on the fact that the structures are generally alike in both sexes of adults, though with some notable exceptions. He describes the stridulating organs on the head, on the prothorax and front legs, on the mesothorax and middle legs, and on the hind legs, elytra, and abdomen.

ROTATORIA OF THE UNITED STATES.—In the "U.S. Fish Commission Bulletin" for 1899, pp. 67-104, are give all species of rotifers, 246 in number, hitherto found in the United States, with special reference to those discovered by the author in the great lakes. Two species *Notops pelagicus* and *Pleurotrocha parasitica*, are described as new. As a general result of his investigation the author formulates the conclusion that the Rotatoria are practically cosmopolitan, any species occurring wherever the conditions necessary to its existence are to be found. In

stagnant swamps all over the world are likely to be found the characteristic rotifers of stagnant water, with little regard to the country ; in clear lake-water, everywhere, the characteristic limnetic Rotifera may be obtained ; in sphagnum swamps the Sphagnum or moss Rotifera. Variation in the rotifer fauna of different countries is probably due to variation in the conditions of existence in the waters of those countries, not to any difficulty in passing from one region to another. In the introduction the author gives a word of warning against the naming of species by those persons who, through want of experience or knowledge of what is known, are not in a position to differentiate new forms. Such work he describes as a positive injury to science and a nuisance to all careful scientific students. It is to be hoped that everyone wishing to describe a new species of rotifer, will learn by heart and inwardly digest this sentence. In the very next paragraph the journal refers to a contribution on this subject in the "Trans. New Zealand Inst." by Mr. F. W. Hilgendorf, which comes under the above strictures. The author succeeded in finding sixteen species of rotifers, twelve of which he describes as new. Half of these can at once be recognized as old acquaintances, and the other half are of no value, and scarcely to be identified as rotifers. The figures of the four plates, remarks the writer of the notice, bear about the same relation to rotifers as the wooden blocks in a child's Noah's Ark do to the animals they pretend to represent.

SCALES OF FISHES.—The scales of fishes are objects of much interest to the geologist and zoologist as well as to the microscopist, and are therefore at all times an interesting study. They are important features in classification, throwing light on the conditions of the waters inhabited by their possessors, and contribute not only to the understanding of the conditions and life of the present seas, but add their quota to the sum of our knowledge of

the former conditions of life upon the earth. The scales of fishes, unlike the scales of most reptiles, are not epidermal appendages—*i. e.*, they do not grow upon the skin, like hairs, nails, or hoofs, but are produced within the substance of the skin, and are covered throughout their extent with a layer of it. A cursory glance will show that the scales figured in books are of two kinds, those having a comb-like appearance at one end, and others without this characteristic. The former are known as "ctenoid," and the latter as "cycloid." In the ctenoid the comb-like end is the free end, the scolloped part being imbedded in the skin. The scales are so arranged in relation to each other that the water glides from the edge of the one on to the middle of the next. The scales overlap in the direction from head to tail of the fish. Two objects are attained. The fish swims with the least possible amount of friction, and the underlying skin is shielded from the constant maceration to which it would be subject if the water were perpetually soaking between. Unlike the armour-plated "placoid" and sheeny-coated "ganoid" fishes of the geologic seas, which still have their representatives in our modern waters, the scales here described are delicate and flexible. "Ctenoid" and "cycloid" differ in appearance; but whether comb-like or rounded the structure is very much the same. An examination will show a number of consecutive lines which correspond approximately to the shape of the scale. A little careful focussing reveals also that the scale, however thin, is thicker at the centre and thin towards the edges. In some scales the concentric lines are continuous across the furrows formed by the deep radiating lines of the upper half. In the flounder and the perch they do not meet, but are broken by a line of transparent matter which appears also to line the whole scale on its underside. The explanation seems to be that the scale grows by the addition of a new layer to its underside, slightly larger than the last,

the boundary edge of which forms the characteristic concentric line. In those scales in which the concentric lines do not cross the furrows the outer layers split as they harden, the interstices being filled with the newly formed transparent matter, and this goes on during the whole of life. The thin flat scale of the eel, which must be searched for beneath the skin, as it does not project from the surface, is a very beautiful object. At first sight, when viewed through a 1-inch objective, it appears to be of a cellular character, but careful study with a $\frac{1}{4}$ -inch and a little management of the illumination shows this appearance to be caused by isolated concretions of carbonate of lime set in a layer of the same. Similar concretions may be easily seen in several of the scales between the outer laminae and the inner transparent layer. All scales are very beautiful; some of them are still more interesting through being mounted as opaque objects. Viewed by polarised light they are of course charming.—*J. Lucas.*

Fish scales make beautiful objects, when viewed with reflected light, the scales of sole being often exhibited in this way, with the light falling on them in such a manner as to show the comb-like teeth. As transparent objects they can be examined with the spot lens or equivalent arrangement, and with polarised light either with or without a selenite plate. As opaque objects it is only necessary to clean and dry the skin; as transparent objects the skin must first be dried and then mounted in Canada balsam. The following is the classification suggested by Agassiz, though subsequently modified, as quoted in the "Micrographic Dictionary." Scales enamelled: Ganoid fishes.—Those the skin of which is regularly covered with angular thick scales, composed internally of bone and externally of enamel. Most of the species are fossil, the sturgeon and bony pike being recent. Placoid fishes.—Skin covered irregularly with large or small plates or points of enamel. Includes all the cartilaginous fishes

of Cuvier except the sturgeon. As examples may be mentioned the sharks and rays. Many are fossil. Scales not enamelled: Ctenoid fishes. Scales horny or bony, serrated or spinous at the posterior margin. Contains the perch and many other existing species, but few fossil. Cycloid fishes.—Scales smooth, horny, or bony, entire at the posterior margin; as the salmon, herring, roach, and most of our edible and freshwater fishes. The majority of the fossil fishes belong to the first two orders, and most of the recent to the third and fourth.—*Science Gossip*.

A Microscopic Proof of the Food of a Prehistoric Man.

T. CHARTERS WHITE.

Several years ago a barrow was opened on the downs near Warminster in which a number of human and animal remains were found heaped over the skeleton of an infant. Together with these were numerous roughly formed flint implements, indicating the period as that of the early Stone Age, the only metal being in the form of a bronze ornament of very primitive design. Having been allowed to make an examination of some of the human jaws, I now describe the condition of one as bearing on the question of prehistoric food.

It may appear impossible to affirm with any certainty the character of the food of individuals who existed probably three thousand or four thousand years ago; but the conditions under which the remains were found place us in a position to state, without any doubt, the nature of food consumed by the individual whose lower jaw is the subject of investigation. The gentleman was perfectly ignorant of the use of a toothbrush, and probably whatever performed an analogous function in others of his surrounding circle failed in his case; for his lower teeth were almost entirely covered by that salivary calculus popularly known as "tartar."

This tartar is deposited on the teeth from the lime salts held in suspension by the saliva, and by its gradual precipitation becomes a hard concrete, not soluble in the ordinary alkaline fluids of the mouth. In it, particles of food are imprisoned by daily deposition, which may remain in the same condition for ages, especially if dry. Here, then, we have this hard, solid concrete only waiting proper treatment to disengage from its calcareous confinement any particles of food closely locked up in its mass.

The method adopted was to clear all the tartar from the lower jaw and then place it in a conical drachm measure, to decalcify it by means of a weak dilution of hydrochloric acid. This solution was afterwards washed away and the sediment examined drop by drop under the microscope, a third of an inch objective being employed in the examination.

The main body of the deposit was made up of amorphous particles, probably disintegrated meal of some kind. Interspersed were numerous granules of a siliceous nature: these were fully accounted for by the extensive grinding away of the summits of the molars, which were eroded into deep pits, and must have been productive of intense discomfort, not to say pain. The granules were found when tested by polarised light to be of two characters: some that were flinty did not answer to that test, while the others did so, and were stated by an eminent geologist to be quartzite. He explained this was probably the result of the corn having been rubbed down in a roughly made quartzite mortar, with a round pebble as a pestle.

Among the first organic remains to be noticed, was the sharply pointed tip of a small fish's tooth, following which were the oval horny cells of some species of fruit resembling those going to make up the parenchyma of apples, then husks of corn, the hairs from the outside of the

husks, a spiral vessel from vegetable tissue, and several small ruby-colored, highly refractive bodies which I could not recognise.

Scattered throughout the collection of sediment were oval bodies resembling starch corpuscles, such as may be found in potatoes, but as they did not give the characteristic black cross under polarised light, it was decided they could not be starch; further, any starch would have been reduced to the amorphous condition found in the general mass of the meal. Their true nature was afterwards made evident by finding a flat plate of cartilage about 1-30th of an inch square, from the free edges of which these oval bodies were being gradually extended, so, that by the disintegration of this substance these bodies in their isolated condition proved a puzzle. Here, then, was evidence that the particles of food locked up in this tartar could be recognised after a lapse of time such as must have occurred since the Stone Age in which they were massicated. No evidences were found indicative of the use of fire in cooking the food; it must therefore have been eaten raw.

Each drop as it was examined was covered by a circular cover-glass of $\frac{1}{8}$ th of an inch diameter and carefully put aside; but to prevent this cover-glass from shifting, a ring of gum-dammar varnish was run round each, and after a few years these preparations were examined again, when it was found the varnish had sucked in by capillary attraction, and these slides, to the number of about thirty, were irretrievably ruined.

Should I ever be so extremely fortunate as to obtain another such specimen of undoubted Stone age antiquity I should dry the deposit at once and mount it in Canada balsam.—*Science Gossip*.

PERSONAL.—Henry L. Ulrich, M. D., is professor of Microscopy and Bacteriology in the Department of Pharmacy, University of Dallas, Texas.

MICROSCOPICAL MANIPULATION.

THE DIFFERENTIATION OF HUMAN AND ANIMAL BLOOD BY THE AID OF A SPECIFIC SERUM.—E. Ziemke refers to investigations of Wasserman, Schutze and Uhlenhuth, who have shown that by injecting rabbits with human blood a change is produced in the rabbit's serum, made evident by the fact that when added to dilute human blood a turbidity is caused, which does not appear with the blood of any other animal except the monkey, and describes some further tests he has made to determine the applicability of the reaction for forensic purposes. Positive results were obtained with fresh blood, dried blood, blood stains on cloth, blood in garden soil, blood from a person poisoned with carbonic oxide, blood on steel implements, blood from the wall of a cellar, blood on wood, blood in glass, blood on paper, the blood of a three-day-old corpse and putrid blood. The stains in several instances were ten or more years old, and where possible, control tests were made on the blood of the common domestic animals. In every case except one a positive result was obtained with the human blood preparations, while the animal tests were all negative; the one failure is attributed to the fact that the stain tested, which dated back to 1883, did not yield any extractive to the soda solution in which it was soaked.—*Medical Record*.

METHOD OF DISTINGUISHING HUMAN BLOOD FROM THAT OF ANIMALS.—C. Tarchetti (*Gazz. degli Osped.* May 19th, 1901) describes a new procedure for this purpose: If into an animal (A) the blood of a different species (B) is injected, then after a certain time the blood of the animal (A) is found to be toxic towards blood of the species (B). Thus, by repeated injections into rabbits of human blood—10 c.cm. or four or five occasions at intervals of about a week—Uhlenhuth and Washermann got from the blood of the rabbit a serum which exhibits hæmotoxic

powers to human blood, not only in a fresh state, but also when dried and redissolved in normal saline solution. Ape's blood was the only other one which behaved like human blood. Washermann and Schultze proceed thus: Dissolve the spot of blood to be examined in a little normal saline solution; filter; place 4 or 5 c.cm. in two small test tubes, to one of which (*a*) add 0.5 c.cm. of rabbit's blood made hæmotoxic as above; to an other (*b*) add 0.5 c.cm. of normal rabbit's blood. A third control tube (*c*) may be made with 4 or 5 c.cm. of solution of the blood of any animal save ape or man in distilled water. Place the solutions in a thermometer at 37 deg. C.; if the spot of blood be human, in an hour's time the tube (*a*) will show a turbidity or a flocculent precipitate, while (*b*) and (*c*) will be perfectly limpid. Tarchetti carried out similar experiments with human blood and that of animals, both fresh and dried, for more than two months on cloth, wool, and knife blades, and found the method reliable. The reaction occurs almost as well at the air temperature as at 37 deg. C. The solutions must be absolutely clear to begin with, and he finds distilled water better for this purpose than normal saline fluid, for it brings all the hæmoglobin out of the corpuscles. He has found that the diagnosis can be at once made with the greatest certainty in a hanging drop under the microscope; a slight uniform precipitate is at once formed, and in a few minutes is seen as islets united in a reticulate pattern much resembling the arrangement of Eberth's bacillus agglutinated by typhoid serum. The same thing is observed in filtered aqueous solutions of dried blood. It is only after a long time (twelve to twenty-four hours) that a similar appearance is seen in blood of other animals.

CEMENT TO STAND SPIRIT.—Dissolve 12 grains of gelatine (previously allowed to swell up in cold water) in 2 oz of hot water. Add to this sufficient fresh fine plaster of Paris to make up a thick cream. Apply this at once to the metal

collar and neck of bottle, and press together. The parts must be scrupulously clean and free from grease before the application of the plaster. Apply an excess of this latter, and after having pushed the parts together, wipe off the superfluity. Let it stand to set for 24 hours.

BACTERIOLOGY.

VARIABILITY OF THE TUBERCLE BACILLUS.—Carl Ramus, in the Jour. Am. Med. Assoc'n, speaking of the variability of the tubercle bacillus concludes as follows:

1. Tubercle bacilli are not so easy to demonstrate as is often believed even though present in large numbers.

2. The fuchsin solutions, like those of other dyes, cannot at all time be absolutely depended upon.

3. Tubercle bacilli from different patients, and from the same patient at different times, will not invariably stain by one method.

4. The bacilli exhibiting these varying staining properties are genuine tubercle bacilli, and not other species of acid-resisting germs.

5. The staining variations probably depended on physical and chemical changes in the bacterial substance, instituted either by antitoxic action or by the products of associated organisms, or by a combination of both.

6. In the absence of demonstrated tubercle bacilli, where physical signs of tuberculosis exist, a prompt diagnosis of that disease should be confidently made in the interest of the patient, and no valuable time be lost in waiting for typical bacilli to appear.

SPUTUM AND URINE.—Suspected cases which may be confirmed by chemical and microscopical examinations are solicited. We don't want your practice, but we want the work that you may not have facilities or apparatus for. Send sputum in a clean, wide-necked bottle (as a 1-dram morphine bottle), prepaid by express, accompanied by a two-dollar bill, and it will be examined for tubercle and

other bacilli, and a report made at once. Send the suspected urine, about four ounces, well corked, prepaid by express, accompanied with a two-dollar bill, and it will be immediately analyzed and report made. Write your name on the wrapper of each bottle. Address The Regular Medical Visitor, 224 M & J Building, St. Louis, Mo.

THREE HUNDRED POUNDS OF COW'S EXCREMENT CONSUMED DAILY.—Professor Conn, of Wesleyan University, is a discussion on the subject of dairy bacteriology, made the statement that the ordinary sediment from milk, when observed through the microscope, is found to consist of sticks, insects' legs and wings, hay, blood, and pus; in fact, almost everything possible in the way of dirt, a large part of it being excrement. It has been estimated that N. Y. City consumes, daily, 300 lbs. of cows' excrement.

ACTION OF COLD ON BACTERIA.—Bacteria possess extraordinary powers of resisting cold. Thus Pictet and Young exposed cultivations of anthrax bacilli to a temperature of -76° C. for twenty hours without destroying their vitality, and similar results were obtained by Colemann and Mickendrick, who found bacteria to be capable of developing after being exposed to temperatures of -6° to -130° C. Yet, although cold does not destroy micro-organisms, it prevents their development, so that putrefactive bacteria remain quiescent in frozen meat. There are, however, certain nonputrefactive bacteria which can develop on meat which is kept only at 0° C. instead of several degrees lower. To this cause Lafar attributes the unpleasant flavor sometimes acquired by meat which has been kept for several days in an ice-chamber. This has been confirmed by Popp, who states that in cement-lined storage chambers the walls when moist swarm with bacteria, which when grown on beef-gelatin produce a mouldy flavor, and he considers these to be the cause of the objectionable flavor occasionally developed in stored

meat. Flesh which has once been frozen is liable to decompose more rapidly than fresh meat, since bacteria can more readily penetrate the loosened intermuscular tissue.

BIOLOGICAL NOTES.

ATOMS.—The Popular Science Monthly for August opens with an article entitled "On Bodies Smaller than Atoms," by Professor J. J. Thomson, the successor of Lord Rayleigh and Maxwell in the chair of physics at Cambridge, who here describes for the first time in popular language the discoveries that have made him the leading living physicist. It seems almost incredible that he should not only have discovered but also weighed bodies smaller than atoms. Indeed most of our ideas are upset by this article. We are, for example, told that the elements are all made out of particles of the same kind, and that Franklin was right in calling electricity a fluid. There are not many outside the ranks of professional students of science who appreciate how completely ideas regarding the constitution of the world have been altered by recent discoveries in electricity. We all know that the applications of electricity have become dominant in the affairs of daily life, and a few years ago the X-rays attracted general attention. The X-rays are a mere corollary to the propositions of recent electrical research. Professor Thomson by his brilliant experiments in the Cavendish Laboratory of Cambridge University has proved that electricity is carried by minute particles much smaller than atoms and that these corpuscles, as he calls them, are split off from atoms. The atoms of the different elements are all made of the same kind of corpuscles. The minuteness of an atom may be appreciated when we learn that if the atoms in a pea became as big as a pea, the pea would be as big as the earth. It is certainly marvelous that bodies smaller than an atom can be measured.

MICRO-ORGANISMS IN COAL BEDS.—A rich source of fossil micro-organisms is the various Paleozoic flints that occur in certain coal basins and other deposits. It was from such that Brongniart described so many remarkable seeds and fruits of Carboniferous plants, chiefly from the basin of Saint-Etienne. They contain all manner of vegetable tissues, and M. Renault finds these permeated with bacteria and fungi. The silica has preserved everything with great exactness and the illustrations of microscopic organisms in this matrix are much clearer than those from the fossil combustibles. Some of these are older than the coal measures and are found in the Culm and even in the Devonian, as those of the Cypridine schists of Saalsfield, in which silicified remains of Cordaioxylon are affected by a Micrococcus (*M. devonicus*). At Estnost, near Autun, the roots of a Lepidodendron have the eggs of an insect or arthropod.—*Popular Science News*.

RED RAIN.—Captain C. J. Gray, collected a small quantity of material after a heavy fall of rain on December 28, 1896, in Melbourne, Australia. I have had the material mounted, but the quantity which I received did not contain the variety of matter that some other correspondents have noted. Observed by transmitted light, there were few characteristic particles, but with the aid a polariscope I was able to detect some small crystalline fragments of the nature of quartz, etc. It seems more than probable that the phenomenon arose in consequence of one of those heavy winds which have been known to carry dust from the Sahara as great a distance as 500 miles, and which in this case may have passed over some sandy tract in a like manner. The material has all the appearance of such dust. There are some interesting references to falls of red rain in P. H. Gosse's "Romance of Natural History," but none of them are of the same nature as the dust at present under consideration.

MICROSCOPICAL SOCIETIES.

QUEKETT MICROSCOPICAL CLUB.—The 388th meeting was held on Friday, June 21. Amongst the additions to the library announced was a bound copy of Mr. E. M. Nelson's collected papers on microscopy and optics, presented by the author, for which a very cordial vote of thanks was passed. Mr. T. J. Davis exhibited a new cover-glass holder he had devised mainly for use in bacteriology. Mr. John Shephard, of Victoria, gave a most interesting account of the pond-life in that colony, so far as it had been investigated, and pointed to the extreme rapidity of development after the rainy season set in. He exhibited a new *Brachionus* under the microscope, and also, preserved in tubes, large colonies of *Lacinularia striolata*, etc., *Lepidurus australis*, and other forms. Prof. Hartog described the peculiar method of feeding in the common *Daphnia*, and a successful way of staining and preserving translucent organisms like *Branchipus* in paraffin. Mr. R. T. Lewis read a further note on *Ixodes reduvius*, and exhibited a stained preparation of the spermatozoa. Mr. Walter Wesché read a short paper on a new male rotifer, *Metopidia solidus*, accompanied by drawings. A preliminary paper on the "Microscopic Structure of Metals and Alloys," by Mr. Sidney Smith, was read. Votes of thanks were passed for these several communications, and the proceedings terminated. The informal meetings of the club for conversation and the exhibition of objects will be held on the first and third Fridays in July, August, and September.

NEW PUBLICATIONS.

"The Microscopy of the More Commonly Occurring Starches." By Professor Hugh Galt. (Bailliere, Tindall & Cox.) Illustrated. This is an unpretentious little vol-

ume which aims at giving the analyst, student, and others who may have to examine materials for adulteration, etc., a basis on which to work. For this purpose a number of photographs have been taken with the aid of a microscope and reproduced in the book with the magnifications in diameters exactly stated. Starch grains are peculiarly unsatisfactory subjects from a photographic standpoint, and the internal markings by which the student is usually directed do not appear conspicuously in the photographs used.

We are not sure the aqueous medium that was used for the specimens is the best mountant, and we have often found that the details of such subjects are better displayed in some media than in others. Still the basis for working and deductions are sound, the contours, and sizes of the various starches are at once apparent, and these, after all, are the principal features which must guide any comparisons or examinations. We believe that the book will be found an extremely useful one to those interested in the subject and possibly to microscopists generally, for starch grains are easily secured, and there is considerable interest attaching to their examination.

MOSESSES WITH A HAND-LENS.—Printed on excellent paper copiously illustrated (8 full-page plates and 44 figures inserted in the text), with new and artistic drawings from nature. No old text-books illustrations, complete glossary, Two easy and accurate keys, one based on habitat, the other on structure. It makes the study of mosses as easy as that of the flowering plants. Price \$1.10. "Even at this day I can vividly recall my experiences when I began the study of the mosses, with no one to go to for assistance, and no book available except Lesquereur & James' Manual. Had such a book as *Mosses with a Hand-lens* been then accessible, it would have saved me many disappointments; not to speak of the loss of much valuable time. I can therefore most cordially commend this

work to the attention of beginners and amateurs as being not only the best, but the only one of its kind, and as being admirably suited to render the assistance they need." G. N. BEST, M. D.

MISCELLANEOUS.

An Astrology for Doctors.—By Alphens. 217 pp. 12 mo. Until within a century, physicians always used astrology and they used it more than all other people, but astronomers used it also. The great Kepler used it and was non-plussed because he failed in an attempt to predict the death of Wallenstein. The position of Uranus is now said to have caused it, but Uranus had not been discovered in Kepler's time and had to be left out of his calculations. One of the most eminent physicians of Boston secretly uses astrology and told this author during the first hour of acquaintance with this author, then totally ignorant of the subject, that he would become a leader in astrology. This book in small compass, opens the whole subject, is beautifully bound and will be sent with the Microscopical Journal of 1901 for two dollars. You cannot afford in ignorance to ignore the matter.

Sea-weeds.—*Tabulæ Phycologicæ* by Fr. T. Kuetzing, in 19 volumes and index, has 1900 finely colored plates and sells for \$500. A Leipzig book-seller, whose address we can give when requested by postal card, has undertaken to reprint volumes I-V, which alone are out of print, so as to sell complete sets for \$125. provided a certain number of orders appear. Kuetzing's unique work is the greatest in existence on this subject and is indispensable for the study of sea-weeds. Our readers should seek to influence wealthy libraries in the U. S., to supply our country with at least a few copies, We are taking the orders for it in America.

Write to this Journal for circular.

EUROPEAN TRAVEL.

Miss Weldon will take six young ladies abroad.

RESTRICTED

HIGHEST REFERENCES

Address, for prospectus of the trip,
Miss WELDON, The Moorings,
HOWARD, P. A.

Specially Prepared Botanists Herbarium Paper.

This paper is offered at the moderate price of \$5.50 per ream
We also furnish.—

No. 1. Genus cover, 16½x24 inches, at \$ 4.00 per 100

2. " " " 2.50 "

3. " " " 1.50 "

Dryers, 12x18 " 2.00 "

Species sheets, 16½x23½ " .50 "

Orders will receive prompt attention. Write for samples.

E. MORRISON PAPER CO.,

1009 Pa. Ave., N. W., Washington, D. C.

100 per ct. Profit. No Grain, Stock or Turt
Speculation. Full par-
ticulars and more sample copies of choice magazines than
you could buy for several dollars mailed for 10 cents. West.
Per. Sub. Agency, 516 E. F. 2nd Ave., Milwaukee, Wis.



CARL REICHERT

MICROSCOPES.

SOLE AGENTS FOR UNITED STATES.

RICHARDS & CO., LTD.,

NEW YORK,

CHICAGO,

30 East 18 Street.

108 Lake Street.

Microscopic Preparations Illustrating the Minute Structure of Vegetable Life.

Being enclosed in a novel transparent envelope, these objects may be examined without removal before mounting. They are prepared with the utmost care by WALTER WHITE, England, and are mostly stained in one or two colors of the most permanent character.

A friend says: The sample section is exquisite. It is so good that I want more. As a well-cut and well-stained section it is equal to anything I have seen in that line.

PRICES.

Catalogue of 172 objects,	- - - - -	\$0.02
Single specimens,	- - - - -	.08
20 specimens, assorted,	- - - - -	1.00

CHAS. W. SMILEY, Washington, D. C.

Microscopical Specialties.

KING'S CEMENTS Have a first-class reputation, and they will sustain it.

KING'S GLYCERINE JELLY is unsurpassed.

THE KING MICROTOME is the best for botanical work.

Send for full list of specialties.

J. D. KING, Cottage City, Mass.

THE FISK TEACHERS' AGENCIES, EVERETT O. FISK & CO., Proprietors.

President.

EVERETT O. FISK, 4 Ashburton Place, Boston, Mass.

Managers.

W. B. HERRICK, 4 Ashburton Place, Boston, Mass.

Mrs. S. D. THURMOND, 1242 Twelfth St., Washington, D. C.

A. G. FISHER, 4 Ashburton Place, Boston, Mass.

MARTHA HOAG, 4 Ashburton Place, Boston, Mass.

HELEN G. EAGER, 4 Ashburton Place, Boston, Mass.

W. O. McTAGGART, 25 King St., West Toronto, Canada.

H. E. CROCKER, 70 Fifth Avenue, New York, N. Y.

W. D. KERR, 70 Fifth Avenue, New York, N. Y.

P. V. HUYSSON, 70 Fifth Avenue, New York, N. Y.

W. O. PRATT, 70 Fifth Avenue, New York, N. Y.

L. E. HALSEY, 355 Wabash Avenue, Chicago, Ill.

J. D. ENGLE, Century Building, Minneapolis, Minn.

Mrs. E. DOWLING ENGLE, Century Bldg., Minneapolis, Minn.

C. O. BOYNTON, 130 1/2 So. Spring St., Los Angeles, Cal.

Send to any of the above agencies for 100-page Agency Manual. Correspondence with employers is invited. Registration forms sent to teachers on application.

The Microscope and Its Revelations

and a review of the whole animal, vegetable, and inorganic kingdoms specially suited for microscopic purposes, must be essentially a cyclopædic work.

Although no changes of so important a character as those which distinguished the seventh edition of this book from the editions that had preceded it have been necessitated, yet a thorough and complete revision of the entire text has been made; eight chapters have been entirely reconstructed, and everything of importance to Microscopy which has transpired in the interval has been noted. This applies to the theory of the Microscope as well as to its use. Many new illustrations have been included and it has been very materially increased in size.

The editor has adopted a classification of microscopes that we hope may be of value to many in the purchase of a stand, especially as he also points out the great and successful efforts which English, Continental, and American makers have made within the last few years to supply good and useful microscopes at greatly reduced prices.

OUTLINE OF CONTENTS

Chapter

- I. Elementary Principles of Microscopical Optics
- II. The Principles and Theory of Vision with the Compound Microscope
- III. The History and Evolution of the Microscope
- IV. Accessory Apparatus
- V. Objectives, Eye-pieces, The Apertometer
- VI. Practical Microscopy; Manipulation and Preservation of the Microscope
- VII. Preparation, Mounting, and Collection of Objects
- VIII. Microscopic Forms of Vegetable Life—Thallophytes
- IX. Fungi
- X. Microscopic Structure of the Higher Cryptograms
- XI. Of the Microscopic Structure of Phanerogamic Plants
- XII. Microscopic Forms of Animal Life—Protozoa
- XIII. Animalcules—Infusoria and Rotifera
- XIV. Foraminifera and Radiolaria
- XV. Sponges and Zoophytes
- XVI. Echinodermata
- XVII. Polyzoa and Tunicata
- XVIII. Mollusca and Brachiopoda
- XIX. Worms
- XX. Crustacea
- XXI. Insects and Arachnida
- XXII. Vertebrated Animals
- XXIII. Application of the Microscope to Geological Investigation
- XXIV. Crystallization, Polarization, Molecular Coalescence
- Appendices and Tables
- Index

1st. Renovation of the surfaces of contact between the oxidisable parts and the external oxygen. More effective elimination of carbon dioxide.†

2nd. Conveyance of the nutritive particles and residues. Nutrition of the masses of alveolar protoplasm, which fulfill the functions of glands, etc., according to principles of Van't Hoff, Becquerel,‡ and Loeb. Circulation of the reserves and circulation in the zymoses.

3rd. Deposition of certain materials and separation of some others according to their solubility, density, and so forth. Concentric formations, incrustations, etc.

The study of these internal currents is, one may say, the chief aim of physiology. They may be explained in terms of known physico-chemical causes rather than by an undiscovered and undiscoverable vital force. The causes are—

A. Diffusion and osmotic currents.

B. Heat. Oxidations.

C. Ingestion of the materials that support the phenomena of diffusion and oxidation.

D. Partial vacua and changes of every kind in internal pressure, induced by evaporation, etc.

The action of these causes may be tested by both the natural and the synthetic protoplasm.

A. The use of gummy water is indispensable if one wishes to observe the circulation of protoplasm in the elements of trees, and the movements are generally dependent on the conditions of diffusion (cf. Butschli's foams).* The currents of the artificial product vary in accordance with diffusive power of the substances, the quantity of liquid, and the presence of some large granulations.

† See A. L. Herrera and D. Vergara Lope, "New Theory of Respiration." Congress at Moscow, 1898.

‡ Becquerel, "Les forces electro-capillaires dans les phenomenes de nutrition." *Comptes rendus Acad. Sci. Paris*, 16 Fevrier 1875.

* See Milne-Edwards, "Anatomie et physiologie comparee."

B. The rapidity of diffusion increases, within certain limits, with an elevation of temperature (Graham). The movements of the protoplasm increase in rapidity between 10 and 22 degrees, becoming slower beyond those limits, and stopping between 45 and 48 degrees.

I have seen that at a suitably high temperature these currents present themselves even in very viscous liquids. It is evident that oxygen as well as the liberation of heat attendant on respiration are equally necessary to every being.

C. The paralysis of artificial currents ceases completely with an addition of peptone or a new quantity of salts.

D. This is an evident principle. It is enough to remember the facts concerning the circulation of sap and blood. The paralysis of internal currents stops life everywhere, decomposition coinciding with an absolute diminution of movement.

The rapidity of the course of blood through the capillaries is identical with that of the currents of protoplasm and varies likewise according to conditions, its result being the same—nutrition and life.

A motionless peripheral layer of serum is observed similar to that apparent in the currents of pseudopodia.

The difference between latent and oscillating life lies, in short, in the almost absolute or simply partial inhibition of the internal currents. Water, heat, and oxygen are required as in a physico-chemical phenomenon, and I have often suspended the currents in my protoplasm by means of desiccation or refrigeration for months together. There is then another argument against my theory which regarded movements as a result of the discharges of carbon dioxide—a theory which has certainly been for me a source of fertile suggestion, though I have now given it up.

The importance of a large quantity of water in internal currents is perfectly demonstrated. I have shown that

dilution has a great influence on the rapidity of the granulations in my artificial protoplasm.

Now, the gray substance contains more water than the substance in the cerebellum, and this has more than the white substance of the brain and medulla (R. Dubois). The neuroplasm has doubtless its currents, and the variations exhibited in their rapidity, as well as the shocks of their molecules and the waves produced, perchance, by the passage of the current from a conductor with a big calibre to a thinner one, may result in certain nervous and continuous actions or sensations, external stimuli provoking the vibrations, as I have studied in mercury.* On the other hand, Dubois says that anæsthetics produce the expulsion of internal water, and I have observed that exhalations of ether have the property of energetically repelling any thin layers of water ("On a Property of Ether," *Memorias y Revista Sociedad Alzate*, 1895-'96, Nos. 5, 6, p. 33). This means that anæsthetics modify the rapidity of the currents or even succeed in completely preventing them.

The action of alcohol on my artificial product is curious, there being a remarkable excitation of the movements followed by their absolute paralysis.

In the sea-urchin egg says Dubois, segmentation can be prevented by hindering hydration by the addition of of salt at 2 per cent to the sea water. When segmentation has already begun, it stops in a strongly salted medium, but it pursues its course directly after some normal water is poured on it; and, what appears more notable, it then continues with increased rapidity. I have observed analogous phenomena in artificial protoplasm.

In a word, the protoplasmic currents have a constructive or formative action comparable to that wrought by rivers on the earth's surface.

* *Natural Science*, December, 1898.

Contractile vacuoles can be explained by an augmentation of tension promoted by some endosmotic currents. The former may be imitated by alternatively stretching and relaxing a plate of gluten.

Life ought not to be likened to a continuous chemical reaction, the mechanism of which remains involved in darkness and unexplained. Life is now to be defined as the result of the physico-chemical action of protoplasmic currents, the cause of such currents being diffusion, heat, and some other secondary factors. Death consists in an absolute suspension of the internal currents in general; latent life is characterised by the establishment of the said currents under the influence of oxygen, heat, and water, in a germ or organism having the structure and chemical elements necessary, and supplied with every nutriment required. Oscillating life is nothing more than an alternate contribution and reassertion of the constructive internal currents (sleep), depending upon the variations of the external temperature. Every physico-chemical or mechanical action capable of affecting the rapidity, direction, and other characters of internal currents must have more or less influence on the phenomena hitherto considered as vital.

There is a new series of proofs; the experiments of the writer on the movements and evolution of alkaline oleates in the Pfeffer's solution. (See "Memorias de la Sociedad Alzate," 1900).

Colouring of Water by Micro-Organisms.

BY JAMES BURTON.

It is well known, not alone to microscopists, that large or small bodies of water are sometimes coloured by the presence of various organisms, either animals or plants, often of microscopic size. Every roadside pond is liable to become of a thick soupy appearance and green colour

from the multiplication in it of the very common *Euglena*, or some other of the unicellular algæ, such as *Protococcus*. Frequently portions in similar localities appear pink or red, owing to the existence in them of immense numbers of some of the *Daphniæ* or water-fleas. In the two cases now to be described, the colour, though extremely marked and characteristic, was the result of the presence of less common organisms.

Early in October the ornamental water in the Botanical Gardens, Regent's Park, appeared of an almost uniform pale green. On close examination this was seen to be due to some minute bodies diffused through the water; they were not merely floating on the surface, but seemed about equally distributed at all visible depths. Every twig and thread of water-weed, etc., at the margin was covered with what looked to the unassisted eye like tiny green balls, while in the quiet corners and backwaters towards which the breeze was blowing, the same bodies were collected in such quantities as to resemble thick light-green paint. Under the microscope it was found that the tiny balls were of irregular outline, and consisted of small algæ in colonies of various sizes, formed of more or less spherical groups. These were made up of very numerous individuals, oval or pear-shaped, so minute that the green colour noticeable in the aggregations was not distinguishable in them. The groups were hollow and surrounded by a thin layer of jelly or mucilage. In many cases there seemed to be spines radiating from the individuals, but these have no real existence, and the appearance is probably due to the mucilage composed of the swollen outer cell-walls of the separate members not having yet entirely coalesced.

The colonies, I think, have no motion within themselves, but, being of nearly the same specific gravity as the water, are very readily moved about by any slight current, such as would be set up by wind, or by the sun

shining on the surface and causing a difference of temperature between different layers. Owing to the disengagement of gas under the influence of light, there is a tendency in the organisms to rise to the surface, while the gelatinous envelopes make them cling to one another and to any object with which they come in contact. Thus are larger and more noticeable masses formed, which, however, have very little cohesion, and disperse again readily. My somewhat doubtful identification of *Coelosphaerium kutzingianum* is approved by an authority who kindly took the trouble to examine specimens. A figure is given in Dr. Cooke's "Introduction to Freshwater Algae," and the size of the individual cells is stated to be 2 to 5 microns, and that of the families 60 microns. The alga is probably not rare; but as it was not recognized by two or three microscopists to whom it was shown, it is most likely seldom noticed, and certainly does not commonly occur in such numbers as to give any tint to the water it inhabits.

Attempts to mount these algæ in several preparations of glycerine were not successful, the groups breaking up. Chlor-zinc-iodine (Schulze's solution) gave better results. So did some other fluid media; but the distinctive characteristics are hardly likely to be enduring.

A somewhat more remarkable instance, both as to the color and its cause, came under notice in January, 1898, in a farm pond at Hampstead. When first seen, the water appeared of a rosy-pink tint, owing to a growth which had formed on dead leaves and debris of various kinds. About a week later, however, the pond presented a striking aspect. When some distance from it, the water seemed to be of a beautiful intense red-purple, so exactly resembling what might be reflected from the sky in a fine winter sunset that I involuntarily turned round as I approached, almost expecting to see the sun setting behind. On closer examination it was seen that every leaf and

twig at the bottom was of this brilliant tint. Some floating patches of *Confervæ* looked like masses of vivid purple, without a particle of their normal green being visible. The organisms producing this effect were spread in a thin layer over everything, and also formed delicate filaments lightly attached, which, however, were dissipated by the slightest movement. On agitating the *Confervæ* or leaves, the color-containing matter was at once diffused through the water.

Under the microscope it was found to consist of exceedingly minute bodies, so small that a very definite outline could scarcely be made out with a power of 500 diameters. These were surrounded by a thin layer of mucilage, and mostly aggregated into hollow spheres; many were solitary, but some were gathered in masses. The filaments it was almost impossible to examine in their original form, but they were composed of the same minute bodies disposed more or less in line. A friend kindly brought the matter under the notice of a professor of botany, who at once identified the organism as a bacterium now named *Beggiatoa roseo-persicina*. He referred me to the paper by Dr. Lankester, published in "The Quarterly Journal of Microscopical Science" for 1873, N. S., vol. xiii. Dr. Lankester there describes, under the name of *Bacterium rubescens*, an organism he discovered in some jars containing putrescent remains of animals and plants which had been undisturbed for a short time. The point to which he pays most attention is the remarkable color of the "plastids," which he considered characteristic of the species. There is little doubt that it is the same species mentioned by Dr. Cooke in his "British Freshwater Algæ" as *Pleurococcus rosco-persicinus* Rabh., with the remark that it is "certainly not a good pleurococcus." He gives the size of the individual cells .0015 to .004 m. It is not mentioned in the same author's "Introduction to Freshwater Algæ." I

do not see the reason for classing this bacterium with *Beggiatoa*, as to me it seems it would be more correctly considered as a *Micrococcus*.

Apart from the color, the most interesting fact about these lower forms of life is that, while ordinarily present to a small extent, occasionally, owing to favorable conditions of environment and food supply, they multiply so enormously as to have the effect described. Thus giving a visible example of what must occur invisibly during epidemics of diseases, such as influenza and plague, which, according to modern science, are caused by micro-organisms distantly related to them.—*Science-Gossip*.

The Blood in Health and Disease.

For anything approaching accurate microscopic blood work it is necessary to have at least a 1-12 inch oil immersion objective with a one inch eye-piece. This combination will magnify about 1000 diameters. Such a power will enable one to study the various kinds of corpuscles and their pathological variations; and will reveal as well the malaria plasmodium and all the smaller bacteria.

Blood specimens are sometimes examined fresh, that is shortly after the blood is drawn and before it has dried; and, secondly, specimens are prepared by drying, fixing, and staining—a process which serves to bring out the various elements of the corpuscles in different colors.

To prepare fresh blood specimens for examination, we should clean a slide and cover slip with alcohol or ether upon a clean towel, and carefully rub dry and polish them in the towel, not touching their surfaces but catching them by the edges to handle them and laying them aside upon clean white paper.

Prick the finger or ear to draw blood, after first cleaning the part with alcohol on the towel and rubbing dry. Wipe away the first drop that appears and then just touch the cover glass to the apex of the next drop so as to obtain

a very small drop upon the glass, and finally place the slip bloody side down, upon the slide. If quickly done, the blood should spread out under the surface of the slip in a thin film. The specimen is then ready for examination. To examine, put upon the cover slip a small drop of cedar oil, place the slip upon the microscope stage, lower its objective until it touches the oil, and focus.

In examining a fresh specimen of blood, the red corpuscles are seen as highly refractive bodies, slightly yellowish perhaps, which are shown to be concave by altering the focus with the fine adjustment screw. They are all of one size in health, and are perfect disks.

The leucocytes are of irregular shapes, and of varying sizes, and contain nuclei which appear somewhat more granular than the rest of the cell body. Some of the leucocytes may be seen to slowly alter their shapes.

The irregularities in size, shape, color and general appearance of the red corpuscles, are of great pathological interest. They may be paler, when the haemoglobin is below normal, but it is difficult to decide this point without the use of a haemoglobinometer or a determination of the specific gravity of the blood. The more important questions of pathologic interest are whether there are present in the blood, red corpuscles larger or smaller than normal, or nucleated red corpuscles, or red corpuscles of irregular shapes.

Abnormally small red blood cells are called *microcytes*, abnormally larger ones are known as *macrocytes*. Thus we may speak of a condition of *microcythaemia* or of *macrocythaemia*.

Nucleated red corpuscles of ordinary size are *erythroblasts* or *normoblasts*, while such nucleated corpuscles of extraordinary size are known as *megaloblasts*, or *gigantoblasts*. The presence of megaloblasts or giant nucleated red cells is regarded as quite a serious symptom and usually forecasts a fatal issue for the case. The megaloblasts

blasts may be from two to five times the size of the ordinary red corpuscle.

The irregularities in shape of the red corpuscles are very marked in many blood affections. The deformed cells may be kidney-shaped, anvil-shaped, flask-shaped, or of such shape as resembles no other object. The condition of the blood characterized by deformed red corpuscles and irregularities also in size is called *poikilocytosis*. Cells otherwise normal whose edges are irregular in outline with toothlike projections are known as *crenated* cell; these are often due to the drying out of the specimen or to some other outside influence.

So far as the leucocytes are concerned, they can be observed more satisfactorily when stained. The fresh unstained specimen is well suited for examination for the malarial plasmodium. The malarial parasite is a mass of clear protoplasm containing black granules which are in active motion. In an unstained specimen, if the parasite contains few granules, it may be difficult to make out.

In a fresh specimen the body of the parasite may sometimes be seen to be in motion, changing its shape, stretching out filaments and exhibiting those activities known as amoeboid movements. Simon in his "Physical Diagnosis" advises a beginner to prepare a saturated solution of methylene blue in a 6 per cent salt solution (isatonic to the blood) and to proceed as follows.

After puncturing to draw blood, wipe off the first drop and apply a very small drop of the solution over the puncture so that the next drop of blood flows out into this solution. Then just touch the cover slip to this and drop it on a slide as directed above for a fresh specimen. The blue stain serves to color the parasite and makes it more easily recognized.

Staining blood specimens is done in a number of ways, but there are two methods in general use—staining with eosin and methylene blue and the use of Ehrlich's tri-acid

stain. The latter stain is so difficult to prepare it is best to buy it already prepared and tested.

For ordinary work in examining blood the following stains and methods of work are perhaps as convenient, simple and efficient as any other. Prepare the solutions as follows:

A. A saturated alcoholic solution of methylene blue, and keep as a stock solution.

B. Stock solution A 1 cc. aqua distillat 9 cc. This is an ordinary counter stain for blood and pus, but the next solution meets almost every need, so that B may be dispensed with.

C. Loeffler's M. B. solution: Stock solution A. 30 cc. 1-10,000 solution of KOH 100 cc. This is the stain to use for the diptheria bacillus, but it is as good as any other preparation to use for a counter stain. The weak aqueous solutions of M.B. deteriorate and need to be frequently renewed.

D. Eosin 0.5 grm. 75 per cent alcohol 100 cc.

E. Ehrlich's tri-acid stain, which is purchased already prepared.

To stain with Eosin and methylene blue :

1. Clean and polish two cover glasses and a slide with alcohol and a towel.

2. Puncture to draw blood. Touch one cover slip lightly to the drop, and place it upon the other cover slip so that the blood spreads between their surfaces. After blood has spread, catch these glasses by their edges and draw them quickly and smoothly apart so that each glass shall be covered with a blood film or "smear."

3. Dry these specimens in the air or by holding them near a flame where the hand can endure the heat. If the specimen dries too slowly, crenated corpuscles are apt to result.

4. Fix the film either by heat or in some solution.

To fix by heat the simplest method is to draw the specimen three times through an alcohol flame—holding the cover slip in a spring forceps. A more accurate method is to place it on a metal plate at 110° F. for 20 minutes. To fix by alcohol, place the slip in alcohol for from a half hour to twenty-four hours. The following mixture will also give excellent results:

Forty-per-cent solution of formaldehyde m. v. Aqua destillat m xlv. alcohol q. s. Immerse the specimen in this solution for five minutes. Then stain.

A. Cover the slip with the eosin solution D (it is only necessary to flood the film side of the specimen). Let it remain from one-half to one minute and wash by running water over the specimen until the water comes away clear.

B. Flood slip with methylene blue solution C. Let it remain about two minutes and wash as before.

6. Dry either as the specimen was first dried, or in clean filter paper.

7. Mount in a half drop of Canada balsam upon a slide, placing the film side down in the balsam. Examine with the oil immersion lens, dropping a half drop of cedar oil on the upper surface of the specimen.

To use Ehrlich's stain we proceed exactly as above excepting we should write:

5. Flood the slip with Ehrlich's tri-acid stain. Let it remain from three to five minutes and wash. The washing and drying should be done quickly, especially if ordinary hydrant water is used.

The first method of staining is equivalent to the use of Plehn's solution which is a mixture of eosin and methylene blue. Staining by eosin and methylene blue causes the red corpuscles to appear red, the cytoplasm of some leucocytes very faintly blue, while all of the neuclei are stained blue. The granules of the eosinophiles stain decidedly red, and the neuclei are a pale blue.

Staining with Ehrlich's tri-acid stain causes the red corpuscles to appear a pale orange color, the nuclei are pale blue, the eosinophile granules are dark red, the neutrophile granules are also red but are distinguished by being smaller than the eosinophile granules.

In both of these methods, the malarial parasite appears as a pale blue body with black granules. These methods if carefully carried out, will meet almost every ordinary need of blood staining.—*Medicus*.

The Microscope and its Revelations.

Review from "Knowledge."

Eighth Edition. (Carpenter.) Edited by the Rev. W. H. Dallinger, D.Sc., D. C. L., LL.D., F. R. S., etc. 817 illustrations in the text, 23 plates, 1136 pages. 8vo, cloth; \$8.00. (J. & A. Churchill.)

The appearance of a new edition of this standard work on the microscope and its many branches is particularly welcome, for it enables a comprehensive survey to be made of the progress that has been effected during the last few years in both the optical and mechanical departments, and indicates the pressure that modern research has brought to bear on manufacturers, causing them to do their utmost to satisfy the needs of workers. In a former edition of this work—the seventh—the editor, the Rev. W. H. Dallinger, condemned in no uncertain language, the microscope known as the Continental Model; and laid down broad but sensible lines for the building of the stand that was to meet the demands of the various workers of the future. It was in that edition also that a strong plea was urged on behalf of the condensers having large aplanatic apertures and for increased accuracy in manipulation generally. A reference to the new edition of the work shows how accurate were the author's opinions and recommendations, and they were

undoubtedly no inconsiderable factor in the general improvement that has since taken place in the design, and accuracy of action, of the best microscopes of to-day. This is revealed in the pages of the new volume, for many of the microscopes therein figured and described as types have been designed since the last edition was published, and owe their origin in some measure to the strong expressions of opinion then made. The present volume gives a clear exposition of knowledge and theory regarding the microscope; and although much of the text is to be found in the former edition, there are many new and re-written portions which add to the value and lucidity of the book. The reviews of the products of the various opticians are generous and fair, and will be found useful to those who need advice in the choice of apparatus.

It is a matter for regret that the publishers have not seen their way to issue the book in two volumes—one devoted to the microscope and its optical fittings, and the other to the various branches of research with which it is associated. Many workers would require only the first part, while the second would appeal to general readers as much as to microscopists. In its present form it is rather a bulky book, especially for those who are residents abroad or travel with their microscopes. A little error concerning cover glasses has been perpetuated in the new volume. Not only are the thicknesses given for the three grades of cover glasses less than can be regularly obtained, but the thinnest covers are universally known as No. 1, the medium as No. 2, and the thick as No. 3, whereas the reverse order is there given. Also the price of a $\frac{1}{8}$ in. .82 N. A. objective on page 374 given as \$15 should be \$7.50. The book is well printed, the illustrations carefully prepared and well displayed, and the book is one that will be found invaluable as a text book to all microscopists.

Extracts from Postal Microscopical Society's Note-books.

Edited for Science Gossip.

DEVELOPMENT OF GNAT.—My object in these slides is to illustrate the transformation of an insect. I am not able to send a slide of the eggs of the gnat, but in "Science for All" Mr. Hammond says that they are laid in small boat-shaped masses which float on the surface of the water. The eggs themselves are of an oval form with a kind of knot at one end, and are arranged side by side and closely packed together. In Duncan's "Transformation of Insects" it is thus written: "The male gnats have pretty hairy antennæ, like little feathers, and the females have antennæ which are almost plain. It is therefore not difficult to distinguish one from the other, and it is rather important, for the females are the blood-suckers. When about to lay their eggs they seek the water, and with the assistance of their long hind legs collect and agglutinate them together and place the little boat-shaped mass upon the surface of the water, and then leave it to its fate." The larvæ are soon hatched, and grow with great rapidity. They are almost always seen with their heads downwards and their tails towards the surface of the water. After the larvæ have grown to a certain size they undergo a change of skin and become nymphs or pupæ, and it may be noticed that when the nymphs come up to the surface of the water they do not present their tails like the larvæ, so as to obtain air, but allow their backs to touch the surface, just where there are two respiratory tubes. When the perfect insect is about to emerge from the nymph stage it floats on the surface of the water, perfectly at rest, and the skin of the back, which is exposed to the air, dries and splits open. Then the perfectly-formed insect begins to come out: first it protrudes its head, then a portion of its body, and after a short time one leg after the other is disengaged from

the nymph skin; after a little while it tries its wings and flies away. It will be noticed that the female gnat has no halteres.—*T. G. Jefferys.*

The best account of the gnat known to me is that given by Professor Miall in his "Natural History of Aquatic Insects," from which the following are excerpts: "Small stagnant pools and ditches are the favorite haunts of the larvæ and pupæ of the gnat. A ditch in a wood choked with fallen leaves is one of the best hunting-grounds, and in the summer months they may be found by the thousand in such places. The larva, when at rest, floats at the surface of the water. Its head, which is provided with vibratile organs suitable for sweeping minute particles into the mouth, is directed downwards, and, when examined by a lens in a good light, appears to be bordered below by a gleaming band. There are no thoracic limbs; the hind limbs, which are long and hooked in the chironomous larvæ, and reduced to a hook-bearing sucker in *Simulium*, now disappear altogether; a new and peculiar organ is developed from the eighth segment of the abdomen. This is a cylindrical respiratory syphon, traversed by two large air-holes, which are continued along the entire length of the body to supply every part with air. The larva ordinarily rests in such a position that the tip of the respiratory syphon is flush with the surface of the water, and thus suspended it feeds incessantly, breathing uninterruptedly at the same time." Professor Miall's explanation as to how it is possible for a larva heavier than water to remain floating at the surface without effort, as the larva of the gnat appears to do, is too long to give here. It deals with the surface film. "After three or four months the larvæ are ready for pupation. By this time the organs of the future fly are almost completely formed, and the pupa assumes a strange shape, very unlike that of the larva. At the head end is a great rounded mass which encloses the wings and legs of the

fly, besides the mouth parts and other organs of the head. Each appendage has its own sheath, part of the proper pupal skin, and the appendages are cemented together by some substance which is dissolved or softened by alcohol. At the tail end is a pair of flaps which form an efficient swimming fan. The body of the pupa, like that of the larva, is abundantly supplied with air-tubes, and a communication with the outer air is still maintained, though in an entirely different way. The air-tubes no longer open towards the head. Just behind the heart of the future fly is a pair of trumpets, so placed that in a position of rest the margins of the trumpets come flush with the surface of the water. Floating in this position the pupa remains so long as it is undisturbed; but if attacked by any of the predatory animals which abound in the fresh water it is able to descend by the powerful swimming movements of its tail." Then follows an explanation, too long to quote, as to why the respiratory organs are changed from the tail end in the larva to the head end in the pupa. "But a time comes when the fly has to escape from the pupa-case. The skin splits along the back of the thorax, and here the fly emerges, extricating its legs, wings, head, and abdomen from their closely-fitting envelope." "The mouth of the female gnat is provided with a case of instruments for piercing the skin and drawing blood. The foremost of these is a tube split along its hinder side, which lies in front of the rest, and is used in suction. This, though long and slender, is stouter than the delicate parts behind it, and it serves to stiffen and protect them; then come fine, long, and slender blades of great delicacy. Two pairs correspond to the mandibles and maxillæ of other insects, though here they are so simplified and attenuated that it is not easy to make out the correspondence. The maxillæ are furnished near their tips with a row of extremely minute saw-teeth. There is also a fifth unpaired imple-

ment, which is an extraordinary development of a part of the insects's mouth, which is usually quite inconspicuous. Besides these piercing implements, the gnat is provided with a soft, flexible sheath which represents the labium. This takes the shape of a tube split along its foreside, which surrounds and protects the delicate parts within. The extremity is divided into two lobes."—*J. J. Wilkinson*.

Quotations from Professor Miall need no further explanation. The gnat (*Culex pipiens*) would make an excellent study for microscopical beginners, perhaps even more so than the common cockroach. We may call attention in addition to the beautiful antennæ of the male gnat, and to the scales upon the wings and body, which latter can be readily removed by means of a camel-hair brush, and so transferred to a slide. The larva in particular makes a most interesting microscopical object, owing to its transparency, which enables the tracheal tubes, the digestive tube, and contractile vessel that performs the duty of the heart to be readily made out. The gnat *C. pipiens* must not be confused with the allied genus *Chironomus*, or Midges.—*Science-Gossip*.

Notes on Microscopy.

M. I. CROSS.

DRAWING WITH THE CAMERA LUCIDA.—Photo-micrography has largely displaced the use of the camera lucida for reproducing structure as seen through the microscope, but in numerous cases photo-micrography does not do justice nor reveal details in such a manner as to permit of a proper judgment being formed of the appearance of the subject; photo-micrography will only show one plane sharply at a time, and all sense of solidity, depth, etc., is lacking. When a drawing of an object is made, the perspective can be reproduced and a far better and truer idea given of the object generally, subject of course to

the delineation being accurate, than photography will permit.

Drawing with a camera lucida is an acquirement which calls for a considerable amount of practice, and is not successfully undertaken without a large amount of skill in the use of the pencil. This condition being fulfilled, very beautiful work can be and frequently is done. Probably the most generally useful and popular of all the camera lucidas is that known as Beale's neutral tint, in which a piece of tinted glass is set at an angle of 45 degrees to the eye-lens of the microscope, the upper surface reflecting the image to the eye. I have a decided preference for this pattern, although it suffers from the disadvantage of necessitating the microscope being set horizontally, and the image is reversed at the top and bottom, while the sides remain constant. Still its simplicity recommends it, and very little acquaintance with it enables one to utilize all its capacity.

For many purposes a camera lucida that works with the microscope vertically, horizontally, or placed at any angle is desirable, and for such the Abbe Camera is generally considered the best. The object is drawn as seen in the microscope, and, when working, the mirror reflects the image of the pencil point and paper on which the pencil is tracing, into the apparent field of view. I have recently been working with Ashe's Camera Lucida with the modifications described by Mr. Scourfield in the *Journal of the Quekett Microscopical Club* for 1900, and believe that for many purposes this will be found the most practical and convenient pattern of camera. It combines the ease of working of the Beale's neutral tint without the transposition of the object and has not the disadvantage of bulk possessed by the Abbe Camera. It can be used at any angle to which the body of the microscope may be inclined, from 45 degrees to the horizontal, quite comfortably, and by turning it round sideways on

•

the eyepiece, it can be used at any angle from the vertical to 45 degrees. The image from the eyepiece is received upon the mirror which consists of a silvered disc of microscope cover-glass mounted on a brass plate, which can be revolved by the pin. The image is then reflected to the neutral tint glass which revolves on the pin and the same effect is produced as in the Beale's pattern, excepting that there is no reversal of the sides.

I can strongly recommend the trial of this little device. Much of the failure in drawing with camera lucidas is due to the attempt to use eyepieces of too high power. It will be invariably found that an eyepiece magnifying six diameters or even less is the most satisfactory, and this equally applies to Ashe's Camera Lucida.

COLORR-PHOTO-MICROGRAPHY.—It has often been deplored that although very exquisite reproductions of delicate structure can be made by photo-micrography, no satisfactory means have been available for reproducing exquisite colour tints, which make the vision of numerous objects through the microscope so entrancing. Attempts have been made, and not without a marked degree of success, by means of the tricolour process of Ives and others, but it called for a high degree of technical skill, and a vast amount of patience, experiment, and time.

The Sanger Shepherd process of natural colour photography overcomes the majority of the difficulties which prevented workers from embarking on attempts in this direction. It is true that the results cannot be printed on paper, but must be viewed as transparencies; but they admit of ready exhibition through a projection lantern, and for direct examination can be held or supported towards a suitable white backing.

The great advantage of it is that no alteration has to be made to the ordinary camera. The recommended adaptation to the camera consists of a repeating back to carry three plates. Immediately in front of these plate-

holders are fixed colour screens, which are guaranteed to be of exactly the correct absorption, and are adjusted by an improved form of Sir W. De W. Abney's colour sensitometer.

Three negatives of the same subject are taken, each with its appropriate colour filter. One print is taken from each of these negatives, and then stained by means of special solutions which are supplied. The three prints are then bound together in superposition to form a finished picture, and the result, if care has been exercised, is very fine.

Those who are in the habit of lecturing on microscopical subjects, or who have hesitated to do so because they cannot sufficiently reproduce the natural appearance of objects, should make a trial of this process, and a very little practice with it will cause them to be gratified with the results.

TO VIEW MULTIPLIED IMAGES—in the facets of the cornea of a beetle's eye is quite simple. An easy method of doing it is to place on the mirror a small cross cut out of black or brown paper, about $\frac{3}{8}$ " long; illuminate in the usual way and focus the facets with $\frac{1}{4}$ " objective. Then gently rack the objective upwards from the object, at the same time moving the paper cross on the mirror, very slightly, with a needle point, and the cross will appear in each of the facets. The needle itself will probably indicate the direction in which the cross should be moved in order to view it in the centre of the facets. The real secret lies not in focussing the facets themselves sharply, but in racking the body upwards until the cross comes into view, and focussing that sharply.

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

ROYAL MICROSCOPICAL SOCIETY.—June 19th, William Carruthers, Esq., F. R. S., President, in the chair. At the

special general meeting several alterations in the by-laws were put and agreed to unanimously. At the ordinary meeting Mr. T. H. Powell exhibited *Coscinodiscus asteromphalus* under a new 1-40 inch apochromatic oil-immersion objective; Mr. J. W. Gordon read a paper entitled "An Examination of the Abbé Diffraction Theory of the Microscope," in which he stated that the above long-accepted explanation of the phenomena of high-power microscopic observation had been adopted on insufficient proof, and would not bear the test of critical examination. The Abbé theory claimed that pictures formed by the microscope of very minute objects were due to diffraction images originated by the object, and that when the oblique rays of light by which these diffraction images existed were excluded no image of the object was possible. This theory had been experimentally illustrated by Professor Abbé by means of a grating on the stage of the microscope and a series of diaphragms behind the microscope object-glass with slits to partially exclude oblique rays. Mr. Gordon showed that, although under such favorable circumstances diffraction effects were produced by fine objects on the stage of the microscope, these effects did not appreciably influence the form of the image. He also showed that the experimental results produced by the above-mentioned diaphragms, which were adduced to prove the theory, were due to a diffraction effect produced by the diaphragms themselves, and not by the grating on the stage of the microscope, the same results being obtained with an aerial image of a grating projected upon the stage by a lens in place of the actual grating. He maintained that in the microscope, as in the telescope, it was necessary to eliminate diffraction effects as far as possible by making lenses of larger aperture, and not, as in Abbé's theory, to include as many diffraction phenomena as possible. Diagrams in illustration of the paper were thrown upon the screen, and

the various experiments referred to were exhibited under a number of microscopes. Professor S. Thompson regretted that he had not heard the first part of the paper, and had not had time to read the advance copy of the paper which had been sent to him. He entirely agreed with Mr. Gordon in rejecting the explanation of the Abbe theory given by Nageli and Schwendener, but found himself at variance with Mr. Gordon on almost every other point, and proceeded to discuss several conclusions arrived at in the paper. Mr. Julius Rheinberg having criticised the paper adversely at considerable length, Mr. Conrad Beck said he did not think it possible for anyone who had followed the experiments described by the author to dispute his contention that the effects observed were produced by the diaphragm behind the objective. The proof that the effects were entirely due to this was shown by the fact that if any of the conditions were altered the experiments did not succeed, and there was no reason why they should not succeed if the Abbé theory were correct. Mr. Gordon contended that he was entitled to the support of Professor Thompson, notwithstanding the impression his speech had probably left on the minds of those present. Professor Thompson agreed with him in throwing over Nageli and Schwendener's explanations, but considered it wrong to throw over the Abbe theory; whereas the quotation at the beginning of the paper made it clear that Professor Abbé had himself thrown it over. In doing so, however, he had promised to elaborate it further. As he had not yet done this, one was obliged to pick it up where it might be possible to find it, and so he was obliged to go to Nageli and Schwendener's book.

THE BRYOLOGIST.

A quarterly journal devoted to the study of North American Mosses
Subscription price fifty cents. Sample copy 15 cents. Mrs. A. M. Smith, 78 Orange Street, Brooklyn, New York.

NEW PUBLICATIONS.

MICROSCOPICAL ANALYSIS OF DRUG POWDERS.—An atlas for all apothecaries, druggists and students of pharmacy. By Dr. Ludwig Koch, Professor of Botany, at Heidelberg University. Appearing in parts—3d Fasciculus. Leipzig and Berlin. The Borntraeger Bros., 1901.

The third fasciculus of this superb work, which completes the first volume, is just at hand and is in every respect well worthy of those that have already appeared and of which we have heretofore spoken at length. The present number finishes up the Barks and takes up and finishes the Elements of Wood Fibres, Wood Parenchymata, etc. Four plates (from X to XIV) and two tables.

We desire to impress upon students of pharmaceutical microscopy the importance of this work. Nowhere else, in all the literature of the profession, can the microscopical structure of this most important part of the stock of every druggist, be found so plainly and excellently depicted. In the text all the methods and procedure are fully explained, so that with the book in hand the druggist is always in position to thoroughly test the purity of his powdered drug.

The price of the volume just completed is 12 marks, and in accordance with the announcement made originally, that of the second volume will be 15 marks. It is obtainable only on subscription, which may be made at a bookstore, or sent directly to the publishers at Berlin.

SANITARY INVESTIGATIONS OF THE ILLINOIS RIVER.—The Illinois State Board of Health has issued a report on the Sanitary Investigations of the Illinois river and its tributaries and the sewage coming from Chicago and the Des Plaine and Illinois river prior to and after the opening of the Chicago Drainage Canal. ("Identification of Bacteria Found in the Waters of the Illinois River and its Principal Tributaries."—The Illinois State Board of Health,

Springfield, pp. 219, one map, 1901.) Dr. Zeit and Dr. Futterer conclude from the results of their bacteriological studies, that the number of bacteria increase with high water and decrease with low water. Seriously polluted water becomes pure again after flowing for some distance. Pathogenic as well as sewage bacteria decrease as the organic matter decreases, but water bacteria increase. The presence of saprophytic bacteria will hasten the removal of organic matter and the death of pathogenic bacteria. The authors did not succeed in finding any typhoid fever bacilli. Experiments indicate that they die in a few days in Lake Michigan tap water. The addition of bouillon keeps them alive a somewhat longer time, but when saprophytes are added at the same time, exhaustion of food supply again causes early death. The *Bacillus coli-communis* may be found in water without sewage pollution and if found may not be virulent. Bacterial purification begins at Joliet. Sewage bacteria decrease markedly at Morris and still more at Ottawa where the bacteriological flora of Illinois river and Fox river do not reveal great differences. Among the pathogenic bacteria found were Anthrax and Tetanus. The *Coli-communis* was found 55 times; *B. lactis aerogenes*, 16 times; *B. enteritidis*, 10 times; *Proteus vulgaris*, 40 times; *P. mirabilis*, 3 times; *B. pyocaneus*, 2 times; *B. tetani*, 3 times; *Staphylococcus pyogenes aureus*, 3 times; *B. anthracis*, 2 times. L. H. PAMMELL.

Outfit for Sale.—Objectives: 1-5" R. & J. Beck, adjustable, $\frac{1}{2}$ " and $1\frac{1}{2}$ " Elliot Bros. adjustable; One bull's-eye condenser, large, never used; One silver side reflector; One stage forceps; 2 life boxes, one large and one small; 20 slides of arranged diatoms, test plates, costing me some \$30 alone. My eyesight having suffered, (else I should not sell), I will take \$50.00 for the whole.

W. C. Pollner, Cleveland, Ohio.

THE AMERICAN

MONTHLY

MICROSCOPICAL JOURNAL.

Entered at the post-office as second-class matter.

VOL. XXII. OCTOBER, 1901. NO. 10.

CONTENTS.

Diatomaceae of Gage's Pond, Topeka, and of Silver Lake.	
Curtis.....	263-267
Disinfection Against Mosquitoes. Rosenau.....	268-272
Structure of Diatoms. Keeley.....	273-275
Diatoms, The Food of Fish in Kansas. Curtis.....	275-280
NOTES BY SHILLINGTON SCALES.—Preparing Small Marine	
Invertebrates; Demonstrations of Microscopic Manipulations; C. Bakers Slide-Lending System.....	280-283
MISCELLANEOUS.—Edward Ward; Formalin as a Preservative for Plants.....	
	283-286

Diatomaceae of Gage's Pond, Topeka, and of Silver Lake.

GEO. H. CURTIS.

Although the Diatomaceæ of the eastern United States have been pretty thoroughly investigated by several competent observers, I believe that little is known as to what forms exist in the West. With the exception of Thomas and Chase's catalogue of the Diatomaceæ of Lake Michigan, which embraces 34 genera and 214 species, and my own catalogue of the Cincinnati forms, 42 genera and 972 species, there are no investigations of western or central-western forms known to me.

In company with Mr. Frank Patrick, I paid a visit to Gage's pond, in the western suburbs of Topeka, about the middle of October. It was dug by Mr. Gage a number of years ago as a fish-pond and stoned up. I did not think of estimating its dimensions while there, but is

perhaps 150 feet long by 50 feet wide, and two or three feet deep. Our object in visiting it was to ascertain if it contained diatomaceous material; and, while there, I made a gathering which, when cleaned up a few days afterward, yielded some very interesting slides, and some *Naviculæ* not previously met with elsewhere.

The most abundant form in the gathering was *Epithemia gibba*, both the long and the short varieties. The most common *Navicula* was *radiosa*. *Cymbella stcmatophora* of several sizes was also common; and *Amphipleura pellucida*, a rare form, more than usually abundant. My gathering was made on the east side, about midway; and it was rather curious that there was no *Amphipleura* in Mr. Patrick's gathering, made only a short distance away at the south end, or from the under sides of the leaves of the water-lilies, of which many were growing in the pond. *Synedra ulna*, var. *longissima*, was abundant, especially in Mr. Patrick's gathering. *Gomphonema* was rather rare. There was a considerable number of large, somewhat curved, sponge spicules. *Navicula cuspidata* was a prominent form—both the long and the short varieties. *Cymbella*, usually one of the most abundant forms in any gathering East, was very scarce at Gage's pond, as well as *Gomphonema*.

The most noticeable thing about the gathering was the remarkable predominance of the rare form, *Epithemia gibba*, of which there were, in a field taken at random, under a quarter-inch objective, no less than seventy-eight individuals, as compared to nine *Cymbella*, four *Navicula*, thirteen *Synedra*, and four *Denticula*—almost three times as many as all the other forms together.

As some may not have had experience with the microscope, I would say that the field of view mentioned above was round, and one-fiftieth of an inch in diameter. This will convey some idea of the exceedingly minute size of these diatoms: that 108 of them, as mentioned above,

could, without any crowding whatever, be placed in a circle of that size.

To give an idea of the rarity of *Epithemia gibba* at other places, I may say that, in the forty-four slides from which my catalogue of the Cincinnati Diatomaceæ was drawn up, representing about thirty different gatherings, this diatom is found in only two of them. In a very remarkable gathering I made from the Fox river, at Elgin, Ill., a half-inch mount of which contained ninety-four recognized species, only two *Epithemia gibba* were observed, and in one from a pond in Oakwood park, Elgin, none; nor were there any in fine gatherings made at places so widely scattered and generally representative of the West and South as Lake Geneva, Wis., Hailey's Springs, Idaho, or Calera, Ala. There were none in a gathering I made from the Chicago water-supply, though it is catalogued in Thomas and Chase's Diatomaceæ of Lake Michigan, from which the city water-supply is derived. Two fine gatherings made in northeastern Ohio, near Ashtabula, contained no *Epithemia gibba*. A gathering made early in October from the fountain basin on Twelfth street, two or three blocks southwest of the capitol, in Topeka, contained hardly anything else but this *Epithemia*; so that its abundance here seems to be a remarkable peculiarity of this locality, depending, perhaps, on some constituent of the water-supply unusually favorable to it. If so, it must, I imagine, be derived from the Republican branch of the river, as a gathering I made from the Blue at Beatrice, Neb., last year, contained none of this diatom.

In connection with *Amphipleura pellucida*, mentioned above, it is not only very rare, but is placed at the end of Moller's test plate as the most difficult test object known to microscopists, and is stated in scientific text-books to be the smallest regularly organized thing known. Of course, the delicate markings referred to below are not

visible at 775 diameters, and the lines across the middle are merely a very coarse imitation of them, to show their direction, etc.

Mr. Patrick informed me that he very carefully examined the alga the *Amphipleura* was growing on and found it to be *Cladaphora fracta* Kg., which I believe only grew over a small space on the east and north walls, a fact very interesting, as showing that it is probably parasitic on this alga, and only found in connection with it, something not before observed, so far as known to me. This would account for its not being found under the lily-pads, or at the south end, where this alga did not grow. The rarity of this diatom may be due to the fact that this alga does not grow everywhere.

I once measured *Amphipleura pellucida* by a Rogers stage micrometer, and found it not quite one two-hundredths of an inch in length. The smallest grains of ordinary sand which can be picked up with a pair of watchmaker's tweezers and arranged as close together as possible under a magnifying glass go only sixty-four to an inch, so that the length of this diatom is only a little over one-quarter of the diameter of one of the finest grains of sand; yet in this short length it is marked with 340 of the finest and most regular lines ever seen ruled across it, and each line apparently composed of rows of beads. I counted these lines on an excellent photograph of it, by Doctor Detmers. A list of the genera and species found at Gage's pond is as follows:

Achnanthes minutissima. *Amphipleura pellucida*. *Amphora libyca*; *ovalis*. *Cocconema australicum*; *cistula*; *lanceolatum*; *mexicanum*; a large unknown, perhaps new. *Cymatopleura elliptica*; *solea* (both long and short). *Cymbella gastroides*; *stomatophora*; *turgidula*. *Denticula elegans*; *tenuis*; *thermalis*. *Diatoma tenue*. *Encyonema lunula*; *turgidum*. *Epithemia gibba*; *gibba*, var. *ventricosum*; *sorex*, short form. *Eunotia gracilis*; *lunaris*; *lunula*. *Fragellaria intermedia*; *mutabilis*.

Gomphonema abbreviatum; *affine*; *affinis*; *angustatum*; *angustatum*,

var. *intermedia*; *angustatum*, var. *producta*, Grun.; *commutatum*; *constrictum*; *gracile*, forma *parva*; *lagenula* Kg.; *mexicanum* Grun.; *obtusatum*; *olivaceum*; *parvulum*; *parvulum*, var. *subcapitata*. *Melosira* *lyrata*, var. (?). *Meridion* *circulare*.

Navicula *acrospheria*, var. (?); *arenaria* Donk.; *bacilliformis*; *biceps* Ehr.; *brebissoni*; *cuspidata*; *decurrens* (Pinn.); *divergens*, forma *minor*; *elliptica*, var. *oblongella*; *flanatica*; *gibba* (Pinn.); *hemiptera*; *interrupta*; *lanceolata*; *lanceolata*, var. much smaller; *mesolepta*; *nodosa*, var.; No. 15; No. 44; No. 45; No. 55, Schmidt's Atlas, pl. 7, with some reserve; *oculata*; *oblonga*; *peregrina*; *producta*; *pseudobacillum*; *radians*; *radiosa*; *radiosa*, var. *acuta*; *retusa*; *rhyncocephala*; *rostellata*; small, elliptical, coarsely marked; *schumanniana*; *stauroneiformis*; *stauoptera*; *stomatophora* Grun.; *subinflata*; *tabellaria* Grun.; *trinodis*; *ventricosa*, forma *minuta*; *viridis* (Pinn.); *viridula* Kg., forma *minor*.

Nitzschia *frustulum*; *sigma*; small, unknown, coarse markings. *Pleurosigma* *spencerii*. *Stauroneis* *anceps*; *phœnicenteron*; unknown, small. *Surirella* *apiculata*; *molleriana*; *ovata*; *ovata*, var.; *panduriformis*; *suevica*. *Synedra* *crotonensis*; *danica*; *familiaris*; *pulchella*; *superba*; *ulna*, var. *longissima*; *ulna*, var. *vitrea*.—Total genera, 21; species, 108.

Many more might undoubtedly be discovered by devoting time to the more thorough examination of the slides, as I never sit down to them without finding something new. As sixty species is a fair average for the best gatherings, it will be seen that this at Gage's pond was unusually good. A gathering made at Silver Lake, twelve miles west of Topeka, yielded much the same forms, except that in a half-inch mount of it only two *Epithemia gibba* were observed, and with the following additions:

Achnanthes *hudsonis*; *exilis*; *lanceolatum*. *Cocconema* *cistula* (a new variety). *Cyclotella* *comta*; *meneghiniana*. *Cymatopleura* *apiculata*. *Eucyonema* *triangulum*. *Fragellaria* *turgens*. *Gomphonema* *affine*, forma *major*; *gracile*. *Melosira* *crenulata*; *varians*. *Navicula* *ambigua*; *ampliata*; *confervacea*, var. *peregrina*, Grun.; *lanceolatum*; *sphærophorum*. *Nitzschia* *dissipata*; *hungarica*; *paradoxa*; *sigmoidea*; *tryblionella*, forma *minor*; *tryblionella* forma *densus striatæ*; *tryblionella*, var. *victoriae*. *Pleurosigma* *eximium*; *hippocampus* (?); *delicatum*. *Surirella* *intermedia*. One additional genus, *Cyclotella*, and twenty-nine species.

For Sale.—A Beck stand with three lenses, very little used. Price \$10. Address: G. W. Wilcox, care this office.

Disinfection Against Mosquitoes.

M. J. ROSENAU, P. A. S.

Until lately, mosquitoes and flies were looked upon merely as annoyances, but since it has been proved that they are able to transmit the infection of pestilential diseases, we must now regard them as dangerous vermin. When the matter is generally understood, it will be a greater reproach to the housewife to have mosquitoes and flies in the home than bed bugs, and it is the duty of sanitarians to spread an abhorrence for these most common and most dangerous of domestic pests. The mosquito is known to transmit the infection of malaria and filariasis. That the mosquito transmits yellow fever must now be accepted as an established fact. The next problem is the destruction of the infected mosquitoes.

It is a well-known fact that formaldehyd gas readily enters into combination with the protoplasm of the lower forms of vegetable life, which makes it a very efficient germicide. It is, however, not toxic to the higher forms of animal life. It is very irritating in its effect upon the mucous membranes of rats, mice, guinea pigs, rabbits, and mammalian animals generally, but not necessarily fatal, even after prolonged exposures. Many insects, such as roaches and the like, may be exposed to strong concentrations of the gas a long time without effect.

Formaldehyd gas kills mosquitoes whenever the gas comes in direct contact with them in sufficient concentration and for a sufficient length of time. When exposed *directly* to the gas produced by any of the methods commonly used for disinfecting purposes, the mosquitoes die within a few minutes. If the insects are confined in a bell jar and some formalin is dropped inside, they soon show signs of agitation and shortly drop down, dead. They may, however, live over night in a very feeble atmosphere of the gas.

The conditions necessary to obtain this direct contact, however, can not always be obtained in actual practice. Rooms are frequently not tight enough to obtain the concentration of the gas required. The mosquitoes can not be held in direct contact with the gas, for their sense of self-preservation helps them to escape. The period of irritation, lasting several minutes even in the bell jar, enables the insects to hide in available places, such as the folds of garments, hangings, or fabrics, or in the cracks and crevices where the gas only reaches in a diluted form. If the room is not thoroughly sealed, some of the mosquitoes will surely get away, for their instinct in finding tiny avenues of escape is remarkable. The escape of one infected mosquito might be the spark that would rekindle an epidemic.

In general, it may be stated that to succeed in killing mosquitoes in a closed space with formaldehyd gas, the following definite requirements are essential. A large volume of the gas must be liberated quickly, so that it may diffuse to all portions of the room in sufficient concentration. The room must not have cracks and chinks where the insects will breathe the fresh air entering, especially if these openings are to windward. The room must not have heavy drapery, clothing, bedding, or other fabrics, so disposed that the insects may hide in the folds, away from the full effects of the gas.

In order to compare the merits of formaldehyd with sulphur dioxid gas in disinfection against mosquitoes, experiments were made by burning sulphur and with the liquid sulphur dioxid gas.

The power of sulphur dioxid to destroy all forms of animal life is well known. On account of its destructive action upon fabrics and metals, this agent is of little practical use in the disinfection of dwelling houses, cabins of ships, and similar places. This destructive action is due to the moisture which combines with the sulphur

dioxid to form sulphurous acid, which is the real disinfecting agent. Dry sulphur dioxid has practically no effect upon bacteria. Our work has shown that very small atmospheres of the dry gas will quickly destroy mosquitoes, and we therefore believe that the destruction of these insects may be accomplished in dwelling houses with little danger of injuring fabrics or tarnishing metals. Sulphur dioxid is so far superior to formaldehyd as an insecticide that even the risk should not outweigh the certainty of its action. The gas may now be obtained in its liquefied form, either in tin cans, in syphons, or in iron cylinders, affording very convenient methods of quickly introducing a given amount of the dry gas into an inclosure.

A series of experiments was also made to determine whether chemically dry sulphur dioxid has insecticidal properties. It is well known that the anhydrous gas has practically no effect upon bacteria. As the dry gas is not destructive to fabrics and metals, it is of considerable practical importance to know whether it will kill mosquitoes.

To this end the liquid sulphur dioxid was liberated in a bell jar, but first passed through 2 drying columns containing pumice stone saturated with sulphuric acid. The moisture contained in the air of the bell jar was eliminated in 2 ways, (1) by drawing air through the drying columns into the bell jar, or (2) by introducing calcium chlorid into the bell jar. It was found, in all these tests, that the mosquitoes were killed, practically instantly, by the dry gas.

Contrary to formaldehyd, which requires an exposure and strength of gas sufficient to destroy spores in order to entirely rid a room of mosquitoes, sulphur dioxid will kill these insects even when the quantity of the disinfectant and the time of exposure are reduced so that non-spore-bearing bacteria are unharmed. Sulphur dioxid

was for a long time used as a disinfecting agent against yellow fever, and experience found it to be trustworthy. But later it was disparaged because laboratory tests showed that it lacked the power of killing spores and has little penetrating power through fabrics. But now that we know it is the mosquito which carries the infection, the usefulness of this agent is revived.

Formaldehyd gas is a feeble insecticide. Mosquitoes may live in a very weak atmosphere of the gas over-night. It will kill them, however, if it is brought in direct contact in the strength and time prescribed for bacterial disinfection. For this purpose any of the accepted methods for evolving the gas is applicable, but the methods which liberate a large volume in a short time are more certain than the slower ones.

Direct contact between the insects and the gas is much more difficult to obtain in ordinary room disinfection against mosquitoes than against germs, because the sense of self-protection helps the former to escape from the effects of the irritating gas. They hide in the folds of towels, bedding, clothing, hangings, fabrics, and out-of-the-way places where the formaldehyd gas does not penetrate in sufficient strength to kill them. The gas is polymerized and deposited as paraform in the meshes of fabrics, which prevents its penetration, and large quantities are lost by being absorbed by the organic matter of fabrics, especially woolens. In our tests, whenever the insects were given favorable hiding places, such as in crumbled paper or in toweling, they quickly took advantage of the best place for themselves and thus escaped destruction.

There is a striking analogy between the strength of the gas and the time of exposure necessary to penetrate the fabrics in order to kill mosquitoes, and the strength and time necessary to penetrate in order to kill the spores of bacteria.

Mosquitoes have a lively instinct in finding cracks or chinks where fresh air may be entering the room, or where the gas is so diluted that they escape destruction. They are able to escape through incredibly small openings. Some of the smaller varieties, such as the *stegomyia fasciata* can get through a wire screen having 12 meshes to the inch. Therefore, formaldehyd gas can not be trusted to kill all the mosquitoes in a room which can not be tightly sealed.

It is concluded, that to succeed in killing all the mosquitoes in a closed space with formaldehyd gas, the following definite requirements are essential: A very large volume of the gas must be liberated quickly, so that it may diffuse to all portions of the space in sufficient concentration. The room must have all the cracks and chinks where the insects may breathe the fresh air carefully sealed by pasting strips of paper over them. The room must not contain heavy folds of drapery, clothing, bedding, or fabrics in heaps, or so disposed that the insects may hide away from the full effects of the gas.

Sulphur dioxid is unexcelled as an insecticide. Very dilute atmospheres of the gas will quickly kill mosquitoes. It is quite as efficacious for this purpose when dry as when moist, whereas the dry gas has practically no power against bacteria. Contrary to formaldehyd it has surprising powers of penetrating through clothing and fabrics, killing the mosquitoes, even when hidden under 4 layers of toweling, in one hour's time—and with very dilute proportions.

This substance, which has so long been disparaged as a disinfectant because it fails to kill spores, must now be considered as holding the first rank in disinfection against yellow fever, malaria, filariasis, and other insect-borne diseases. A pamphlet giving in detail all the experiments by which the above conclusions were reached can be had from the Marine Hospital Bureau.

Structure of Diatoms.

FRANK J. KEELEY.

In studying the structure of diatom valves some years ago, the method employed, mounting broken valves at right angles to the cover glass, proved efficient for most of the coarsely marked forms, but failed with certain species of *Aulacodiscus*.

Such forms as *A. sollittianus*, *A. margarataceous*, etc., yielded satisfactory sectional views and proved not to differ materially in structure from *Coscinodiscus* but another group, including *A. oreganus*, *A. rogersii*, *A. jansschii*, etc., proved too opaque for the elucidation of their structure by this method. Further examination of fragments in which the plates were separated indicated, however, that the typical "honeycomb" cellular structure was likewise present in these species, but masked by the unusual character of the external plate, which differs from that of other diatoms in having the finer secondary structure between, rather than over, the large cells of the middle plate.

Recently, with the view of further determining the relations of this structure to that of other species, a special mount was prepared, including *A. oreganus*, *A. rogersii*, with typical species of *Concinodiscus*, *Triceratium*, *Actinocyclus*, *Actinoptychus*, etc. The various forms were arranged in a line on a square cover-glass, supported on the slide by bands of cement at two opposite edges, thus permitting the fluids of varying refractive indices to be passed under the cover and withdrawn by the use of blotting paper in the manner familiarly known as "irrigation."

The fluids employed consisted of absolute alcohol, cedar oil, oil of cassia and mixtures of same, giving refractive indices from about 1.37 to over 1.60. Starting with the lowest refractive index, the appearance of each diatom was carefully noted under low, medium and high aperture

objectives, and it was found that all the species represented, with the exception of the two *Aulacodiscii*, became fainter as the refractive index was increased up to about 1.435, when they were entirely invisible, except where in contact with the cover-glass. As the index of the medium surrounding them was increased above this point they became more distinct, the coarser forms being almost opaque in oil of cassia. This is exactly what should be expected, either on theoretical grounds or based on previously published experiments, but in the case of the two species of *Aulacodiscus* mentioned, the distinctness of visibility under a low power seemed to increase from the start, and in the medium where other forms disappeared they were even more strongly outlined than in alcohol, while under an oil immersion-objective no difference could be noted in the sharpness and contrast with which the secondary structure was shown in any of the various fluids, although portions of the internal plates, which extended beyond the external plate in broken forms, were extinguished with the rest of the diatoms on the slide, showing that the anomalous behavior of these species was confined to the external plate, containing the secondary structure. Neither heating to redness on platinum foil nor boiling in strong acids has the least effect on the appearance of the secondary structure, nor is there anything to indicate that its appearance is due to difference in composition rather than of structure. With the facts at present available it would be useless to hazard a conjecture as to the true nature of this structure, but it may be safely affirmed that in the external plate of this group of species of *Aulacodiscus* we have a structure essentially different from that found among other diatoms.

Aulacodiscus Oreganus is one of the few diatoms that show bright colors with central transmitted light. The two valves of this species included on slide under observation, when examined with a three-fourths-inch objec-

tive of .25 N. A., were bronze-yellow when dry, yellowish gray in alcohol, blueish gray in medium of 1.41 R. I., iridescent blue in medium of 1.44 R. I., deep greenish blue in cedar oil, dark green and pink in oil of cassia.

The question of colors shown by diatoms in direct light has recently been treated in the Journal of the Quecket Club, with special reference to *Actinocyclus ralfsii*, by E. M. Nelson, who has shown that the color cannot be due to diffraction. The two valves of *A. ralfsii* which were included in the previously described slide showed only pale brown and grayish tints in media of R. I. below 150, and extinguished with the other forms in one of R. I. about 1.43. In cedar oil one valve showed a blue color and in oil of cassia both became brilliant with green, blue, purple and yellow. Under wide aperture objectives the color is not visible when diatom is sharply in focus, but it appears as soon as thrown slightly out of focus. This color appears to be due to dispersion, and its nature and cause might possibly be further elucidated by studying the effect produced by different media such as were employed in this case.—*Proc. Phila. Acad. Natural Sciences*.

Diatoms, The Food of Fish in Kansas.

GEO. H. CURTIS.

Mr. S. G. Mead, of McPherson, gave me a small fish about two inches long, which he caught at Belvidere, Kiowa county, Kansas, last fall. It was apparently a young perch, to judge from its shape and the dark bands along its sides. Having a curiosity to know what its food had consisted of, I undertook a microscopical examination of the contents of the digestive tract; but the difficulty of arriving at satisfactory results was much increased by the carbolic acid and oil the fish had been preserved in, which interfered very much with the proper

action of chemicals, especially acids, and did not seem to yield well to either soap, benzine, or alcohol.

The investigation was, therefore, not altogether so satisfactory as I could wish; but was sufficiently so to establish the main points, and to prove that their food consists very largely of diatoms, mostly *Naviculæ*, of the *radiosa* type; of which I was able to make a very satisfactory examination, to be referred to again further on. There were also many starch grains, shown by the polariscope to be those of the potato, and about as many, perhaps, which were smaller, and possibly derived from bits of bread. There were also a number of green bodies of roundish contour, which were without much doubt desmids. They had been too long subjected to the action of the gastric secretions for the species to be exactly made out, but they were probably *Cosmariums* of some sort; and their numbers were apparently too small for them to have formed a very important part of the fish's diet. About a dozen grains of corn-smut were met with, all in one place.

There was a very considerable quantity of white sand in the stomach and intestines, hardly any field of view in the microscope one-fiftieth of an inch in diameter being without a number of grains of it. They were generally of about the same size as ordinary river sand, and polarized equally well. In one field of the size mentioned above there were thirteen grains of it, in another nine, and in a third five, of three taken at random. It may be possible, though hardly probable, that this sand was swallowed accidentally. It is, however, far more likely that it was swallowed designedly, to aid the process of digestion, as is the case with birds; and the size of these sand grains would, considering the difference in size of the two creatures, apparently bear a just proportion to the little stones swallowed for this purpose by fowls.

They may also have been swallowed to act by their

weight as ballast to counteract the natural buoyancy of the body, like the stones of considerable size usually found in the stomachs of alligators, and which are supposed to have been swallowed to assist them in remaining at the bottom.

The fact that there were no grains of black sand among it, which does not polarize, would rather seem to lend support to the digestive theory; inasmuch as white sand, being composed of quartz, or almost pure silica, and hard enough to scratch glass, would naturally be selected by them to assist in the grinding or trituration of their food, rather than the much softer black sand.

There was observed at one place an agglomeration of small, round grains, quite smooth outside, like very small fish eggs, which they perhaps were, or spores of some small toadstool or other fungus. They were transparent, and not much over one-quarter the size of the grains of sand mentioned above.

A great quantity of some dark-colored substance, finely comminuted and apparently of animal origin, was found, perhaps the remains of worms or meat of some kind; but, although most carefully sought for, there were no feet, wings, scales of lepidoptera, parts of insects, crustaceans, or muscular fibers of any sort among it, such as would have been likely to have survived the digestive process and given a clew to its character.

As we may see from the smallness and degree of convexity of their eyes that fish must be capable of seeing things infinitely smaller than would be visible to the human eye, this matter was perhaps composed of minute particles of both animal and vegetable origin which the fish met with and swallowed as it swam about, and which were perhaps too small to preserve any definite recognizable character, especially after passing through the stomach.

Their principal food, though, to judge from the great

numbers of frustules of different kinds found in the stomach and intestines, were diatoms, the outer shells of which being composed of almost pure silica, are well-nigh indestructible by the digestive process, fire, or the strongest acids.

After preparing the diatoms for examination under the microscope, it was seen that the greater part of these small organisms in view were *Navicula* of small size, of the type known as *radiosa*, *arenaria*, etc., of two or three sizes, or of the *lanceolata* form, with divergent striæ, such as are figured in Schmidt's Atlas of the Diatomaceæ (plate 47) or varieties of that type. Some were much larger and some smaller, but mostly of the same general type.

Gomphonema was, as usual in Kansas gatherings, very rare, though four or five species were met with. *Cymbella*, also one of the commonest forms anywhere East, was equally scarce; and I had about concluded that none except small forms were present, when I unexpectedly came across an *Amphiprora* of the largest size, and of a decidedly rare variety, not found in the forty-four Cincinnati slides. The individuals of this family are among the largest diatoms; and they were remarkably abundant, as if there was a savor or a large body of nourishment in them which had especially appealed to the fish's taste.

A noticeable thing was not only the abundance of this large and rare *Amphiprora* not found at Gage's pond or Silver Lake, but the remarkably large number of fine *Pleurosigma*, mostly *spencerii* or varieties, every field containing at least one and often several.

An unusually large form of *Amphora lineata*, not found at Gage's pond, Silver Lake, or in the forty-four slides of Cincinnati diatoms, was quite abundant. Only one *Navicula* of the *rhomboides* type was seen, and that was a variety, the *Colletonema vulgare* of Thwaites. *Staurois phænicenteron*, one of the few distinctively fresh water forms said to be found everywhere, was not met with.

Epithemia gibba, so remarkably abundant at Topeka, was present, but rather uncommon. Of the three or four species of *Nitzschia*, only one seemed to be of a common variety, and one of them, *Nitzschia sigma*, is catalogued by different authorities as a marine form. A most remarkable thing was that not a single *Surirella* of any kind was seen in the three slides mounted. As they are one of the most abundant forms everywhere, and there being plenty near at Medora, we must either conclude that there were none where the fish lived, or that they possessed some poisonous or other undesirable qualities which caused him to reject them.

One of the most remarkable things found was *Mastogloia*. The genus is almost exclusively marine or brackish, and only one of the two species are ever found in fresh water, and they are excessively rare. This one, *M. lacustris*, was not found at Cincinnati; though an allied species, *M. lanceolata*, was recognized there with some slight reserve. It is also catalogued by Thomas and Chase, but none of either was found at Gage's pond or Silver Lake. Another seems to be what Grunow calls *Nitzschia apiculata*, though the blank line down the center and the absence of alea seem to identify it with *Synedra*.

To give an idea of the relative proportions of the genera present in a field of view one-fiftieth of an inch in diameter, selected merely because it had an *Amphiprora* in it, so as to include that, there were the one *Amphiprora*, one *Amphora*, one *Cymbella*, two *Nitzschia*, three *Pleurosigma*, and thirty-four *Navicula*.

The genera and species, so far as observed, were as follows:

Amphiprora conspicua (?), (perhaps columetica?); paludosa W. S., said to be British. *Amphora* cymbifera Greg.; lineata; No. 18, Schmidt's Atlas, pl. 39. *Cocconeis* pediculus. *Cocconema* australicum A. S.; cistula; helveticum; hungaricum; lanceolatum; mexicanum. *Cyclotella* rotula; a small unknown.

Cymbella affinis; *gastroides*; *helvetica*; *kamchatica* Grun.; *minuscula* Grun.; No. 40 of Sch. 9, not named; *stomatophora*; *tumidula*; *turgidula*; two small unknown. *Denticula splendens*. *Encyonema lunula*. *Epithemia gibba*; *gibba*. var. *ventricosum*; *gibberula*; like *musculus*, but ends not so sharp; uncertain; *zebra*. *Gomphonema abbreviatum*; *angustatum*, var. *intermedia*; *capitatum*; *clavatum*; *commutatum*, var. *subramosum*; *intricatum*, var. *pumila*; *olivaceum*; *olivaceum*, var. *vulgaris*; *ventricosum*. *Homœocladia sigmoidea*. *Mastagloia smithii* Thw., var. *lacustris*, Grun.

Navicula amphiceros (?); *bacillum*; *borealis* (var. small, with nine coarse striæ); *brebissonii*; *cymbula* Donk; *elliptica*; *elliptica*, var. *oblongella*; *gracilis* (Kg.) Grun.; *gregaria* Donk; *interrupta* (Pinn.) S. W.; *lanceolata* (Kg.), var.; *leptogongyla*; *longa*; *macra*; *mutica*, var. *goeppertiana*; large, coarsely marked, lanceolate, unknown; No. 11 of Schmidt's 47, not named; No. 13 of same, not named; No. 15 of same, not named; No. 22 of Schmidt's 44, but rather coarser; No. 32 of Schmidt's 44, with some reserve; *obtusata*; *pumila* Grun.; *radiosa* Kg.; *radiosa*, var. *acuta*; *rhomboides*, var. (*Colletonema vulgare* Thw.); *rupestris* (Pinn.) Grun.; *smithii* (?); *subcapitata*, var. *stauroneiformis*; *subinflata*; *stauoptera*; *stauoptera parva* Grun.; *tabellaria*; *tenella*; unknown, perhaps *naveana* (?).

Nitzschia amphioxys, var. *vivax*; *angustata*; *frustulum*; *heufferiana*; *hungaricum*; *sigma*; *stagnarum* Rabh.; *triblionella*. *Pleurosigma gracilentum* Rabh.; *spencerii*; *sciotense*; *kutzingii*. *Synedra acus*; *crotonensis*; *danica*; *familiaris*; an end of, perhaps, *Chaseii* (?); *pulchella*, forma major; *ulna*.—Total genera, 16; species, 100.

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

PREPARING SMALL MARINE INVERTEBRATES.—The following method of preparing small marine invertebrates for microscopic study may be of service to some of our readers. It was originally contributed to the "Journal of Applied Microscopy" by Mr. H. P. Johnson, the aim being to retain as fully as possible the natural form, transparency, and coloring, and at the same time to have the specimen instantly accessible for re-examination. The specimen is placed on a slide in a few drops of pure sea water, and slightly compressed with a cover-glass provided with wax feet. The compression can be quite accurately regulated by pressing down the wax feet at the

corners of the cover-glass, or prying up the cover-glass, a little at one or more corners with the point of a scalpel. If the specimen is a worm, it will contract at first; but afterwards will usually become fairly extended. After two or three hours the worm, although still living, becomes almost perfectly quiescent. A few drops of a 4 per cent solution of formaldehyde are then run under the cover-glass, its flow being hastened by draining away with bibulous paper an equal quantity of water at the opposite side. The worm should die in a fairly extended condition. A sufficient quantity of formaldehyde should be run under to displace all the sea water. After an hour or so the gradual replacement of the formaldehyde with glycerine may begin. Mr. Johnson has always used undiluted glycerine, but suggests that a mixture of equal parts of glycerine and water might be safer for very delicate objects. The glycerine is applied in the same way as the formaldehyde, but more gradually—only two or three drops at a time. After the specimen has become completely surrounded and permeated with pure glycerine, the mount is sealed with Venice turpentine in the manner explained in Lee's "Vade Mecum," fifth edition, p. 291.

The preparations will keep almost indefinitely without sealing, but with the obvious disadvantages that the glycerine is likely to flow over the slide in moist weather, and a mist gathers on the cover-glass. The preparation should be flat at all times. This method has been found to meet all the requirements of the case for small Annelids and Echinoderms, and would probably be equally successful for a wide range of minute animal forms, excepting always those with impermeable chitinous integuments, like the Arthropods. *Syllidae* and other small Polychetes up to a length of four or five centimetres have been successfully treated, and preparations made three years ago are as beautiful and instructive as at first.

DEMONSTRATIONS OF MICROSCOPIC MANIPULATIONS.—Mr. C. Baker informs us that he has decided to set aside four afternoons in each month from October to the end of June for the demonstration of microscopic manipulation. These demonstrations will be given on the first and third Fridays and second and fourth Tuesdays, from 3 to 6 P.M. Each demonstration will consist of an exhibition of about eight microscopes, together with illustrative diagrams; and the instruments will be set up, ready for inspection, at the times stated, so that those who have but a short time at their disposal will not be delayed by preliminary preparations. Three of the demonstrations will deal with illumination, one with the comparison and testing of objectives, and two with the various methods of recording observations. Further particulars can be obtained from Mr. C. Baker, 244 High Holborn, W.C., and we need only to add that the demonstrations will be free to all, and no obligation to purchase is incurred by those availing themselves of the offer. It cannot be too strongly insisted upon that the modern microscope is essentially an instrument of precision, and requires education in its use if full advantage is to be taken of its capabilities. We hope therefore, that these demonstrations may prove successful.

EDWARD WARD.—A well-known figure in Manchester scientific society was recently removed by the death of Mr. Edward Ward at the age of 57 years. He was born at Coventry, where in his early life he worked as a ribbon weaver. Having a natural taste for scientific investigation, he soon became possessed of a microscope and later of a primitive camera. His tastes quickly brought him into association with others, which led to his leaving the loom for the vocation of commercial traveller. Notwithstanding the difficulties incident upon the constant change of locality when thus occupied, he contrived while on his journeys to study, dissect, stain and mount thousands of

objects. In 1887 he issued his first list of purely scientific lantern slides, which gave an impetus to science work in the district. He was one of the founders of the Manchester Microscopical Society, and for several years one of its presidents, and a lecturer in its Extension Section. It will, however, be on account of his photographic work that he will be best remembered. It is said that he took no less than ten thousand photographs of Geological Sections during the construction of the Manchester Ship Canal, and also of its chief engineering features. To attain such a remarkable pictorial history of that gigantic undertaking, Mr. Ward used at least once a month to walk along the whole course of the works between Manchester and the Mersey above Liverpool during the period of construction, which lasted beyond five years.

C. BAKER'S SLIDE-LENDING SYSTEM.—The system of slide lending—initiated, we believe, by Mr. C. Baker, and since adopted by other firms, such as Messrs. Watson & Sons, of London, and Mr. Abraham Flatters, of Manchester—was a departure that had much to recommend it. Mr. Baker's system, in brief, is that for a subscription of \$5, the subscriber becomes the recipient of twelve deliveries of twenty slides each, post free both ways. These slides can be arranged for delivery at stated times—say, fortnightly during the winter months, or the time of receipt and return can be left to the varying convenience of the subscriber. The choice of slides is most comprehensive; in the list before us we note twenty-five sets of diatoms alone, and four sets of bacteria. The mere examination of slides, however, whether arranged for a definite purpose or not, falls far short in interest and in educational value of the same slides accompanied by the necessary descriptions and explanations. Recognizing this, Mr. Baker has now arranged that full descriptions shall accompany the slides lent, and has given us the opportunity of perusing several of these sets of detailed notes.

The scheme is excellently carried out by competent writers, though the work entailed thereby must have been considerable, as the notes run in each case into many pages. For instance, a set of twenty slides dealing with bacteria is accompanied by a succinct and carefully-written introduction to their study, after which follow detailed descriptions of the respective slides, so that the examination of each becomes a little lesson in itself, the methods of examination and, in certain cases, of preparation not being omitted. Another set of twenty slides deals with Mollusca, and in the accompanying descriptions we recognize a well-known writer on marine zoology. The following extracts will show the nature of these notes.

Dealing with the palates of Mollusca, the writer says: "With but two or three exceptions the mouths of Gastropods and Cephalopods are furnished with a tooth-bearing, ribbon-shaped band, variously known as the radula, odontophore, lingual ribbon, palate, or tongue; an organ of use in scraping, cutting, boring, or masticating, according to the habit of the particular animal. It is often of very considerable length, and consists of an anterior portion working over a cartilaginous swelling, the regular cartilage, upon the floor of the mouth, while the longer hinder portion is lodged and formed within a large radular sac, which in reality is a deep cylindrical depression of the floor of the mouth. When the radular is very long, as in the limpet, the radular sac lies free, folded several times upon itself, within the body-cavity immediately between the viscera and muscular foot disc. Throughout life new teeth are continuously added by secreting cells situated at the blind end of the radular sac; the singly-refractile core of each tooth being secreted by certain cells upon the floor of the sac, while the enamel-like, doubly-refractile outer layer is laid on by those of the dorsal wall.

As mentioned, that part of the radular which is in use plays over a pulley-like cartilaginous cushion, and by the

alternate contraction of two sets of muscles, protractors and retractors, attached at one end to the base of the cushion and at the other to the radula, the latter is dragged backwards and forwards over the cartilaginous pad, as an ostler polishes the inside of fixed rings by pulling a cloth to and fro within. Listen to the limpets as they rasp slowly over the rocks, and you will understand clearly how effective is this radula in scraping off minute vegetation that coats the rock. The sound given out is too definite to be mistaken. The scraping action of the radula is also very easily studied in a fresh-water aquarium containing a few water-snails. As the teeth in front wear down, the ribbon is bodily moved forward sufficiently to permit new teeth to come into use." Then follows a detailed description of the teeth and of the classification.

From notes accompanying a miscellaneous set of slides we extract the following remarks on a slide showing the prismatic raphides in the cuticle of an onion (*Allium cepa*): "Lime enters largely into the composition of all organic bodies. In human bones, for example, the salts of lime constitute 65 per cent of the whole mass, or more than double the amount of animal matter. There are very few plants in which these limey crystals or raphides are not found. They vary considerably in size and shape, and it is by no means difficult to detect them by cutting thin sections of plants and examining them under the microscope. A glass slip, a cover-glass, and a little water are all the mounting materials necessary. They will not, of course, come out so clearly as in a slide made by a professional mounter; but it is always interesting to do something for oneself, and facts observed in this way are firmly impressed on the memory. The simplest form of raphides is to be found in the lilies, where these bodies occur in the form of bundles of needle-like rods occupying the centre of the cell. In the strip from the outside of a lily stem they are seen under an inch as an almost solid mass in

the proteoplasm of the cell; but the $\frac{1}{4}$ -inch will resolve this mass into its constituent parts, when the needle-like bodies lying side by side can be made out distinctly. In the onion the raphides are prismatic in form, and may be seen scattered over the whole section; the walls of the cells in which they are enclosed can be clearly made out, and each cell contains a single crystal or raphia."

FORMALIN AS A PRESERVATIVE FOR PLANTS.—The use of formalin for the preservation of zoological specimens is now very general. Its application to the preservation of plants and flowers, however, is quite new. The most satisfactory results are obtained with a 5 per cent solution of formaldehyde, *i. e.* an eighth of the strength of the commercial formalin, which contains 40 per cent of formaldehyde. The flowers and portions of plants immersed in this and kept in the dark remained intact, whilst the tissues became more or less translucent, showing the structure. After seventeen months, yellow calceolaria flowers had lost but little of their color, whilst a tulip and hyacinth had lost about 30 per cent. A pansy exposed to diffused light in a 5 per cent solution was rapidly bleached, with the exception of the lower yellow petal. A white tulip became translucent, but retained its external form perfectly. The odor of mignonette was still perceptible after four months, notwithstanding the penetrating odor of the formalin itself. Unfortunately the solution soon bleached blue colors. A blue hyacinth became opaque white in two days and translucent in six months. Green leaves became only slightly translucent, and were otherwise unchanged. In order to prevent the bleaching action of sunlight it was found essential to keep the specimens in as dark a place as possible. The preservative action of the formalin is due to its destroying all external micro-organisms, and preventing the interaction of the plant-cells by contracting their proteoplasm.—*C. A. Mitchell, London, in Science-Gossip.*

THE AMERICAN

MONTHLY

MICROSCOPICAL JOURNAL.

Entered at the post-office as second-class matter.

VOL. XXII. NOVEMBER, 1901. NO. 11.

CONTENTS.

Ethmoid Diaphragms. Ordway.....	287-294
The Fungi. Massey.....	295-298
Extracts from Microscopical Society's Note—Books.—Eristalis Tenax, Longitudinal Section of Halter; Sarcophaga Carnaria; Anterior Thoracic Spiracle of Blow-fly; Proboscis of Butterfly.....	299-302
NOTES BY SHILLINGTON SCALES, AND H. A. HAIG.—Coloring of Water by Micro-Organisms; Bract and Fruit-Scale Coniferae; The Structure of the Nucleolus; Thermal Death-Points of Bacteria.....	303 306
Microscopical Society's.—Royal Microscopical Society.....	306-307
New Publications. — Gage's Introduction to Microscopic Methods and Histology.....	307-308
Miscellaneous.—Asplanchna; Liquid Amber; Storm Effects; Vaccination; Carborundum.....	308-310

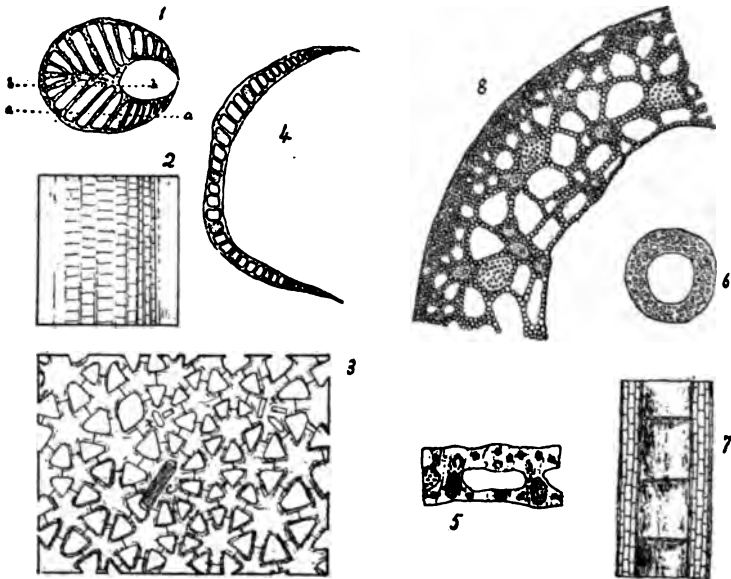
Ethmoid Diaphragms.

JOHN M. ORDWAY.

In some monocotyledonous plants there is a kind of tissue of which there is no description in any botanical work within my reach. This constitutes the cross partitions or diaphragms of the air passages extending the whole length of the petioles, leaves, or scapes. These diaphragms consist of one layer of flat, branching cells which join together so as to leave triangular, square, or oval apertures allowing easy communication between the different compartments of the same longitudinal series. If they have not been already named, they may very properly be called ETHMOID diaphragms,—from Ethmos, a colander.

Good examples are afforded by the tropical banana plant, *Musa sapientum*. Fig. 1 shows a cross section of

the banana petiole one fourth smaller than the natural size. Fig. 2 represents a short piece of a section cut downwards from the line *a a* of Fig. 1. Fig. 3 gives a portion of an ethmoid diaphragm magnified about fifty times. Fig. 4 is a tranverse section, of one half the actual size of a sheath, taken a little below where it narrows and bends out to become the petiole proper. These sheaths extend down to the ground and together form the body of the plant. Air passages with ethmoids also make up



a part of the large red bracts which protect the successive tiers of flowers and are thrown off, one by one, as the fruit develops. Fig. 5 shows a cross section of one them enlarged five times, the upper part being the outside.

The diaphragms, as shown in fig. 2, are hardly two millimetres apart. Therefore if we examine with the microscope several successive cross slices of a petiole, we shall be sure to find among them some that have one or more of the diaphragms in place. Or we may split off the side as in fig. 2, so as to expose the interior, and

then cut just above and just below one of the plates. But it is better to remove the parts outside of *a a* and *b b* of fig. 1 and dissect out one of the diaphragms to examine by itself.

By suitable focussing it will be seen that the cells are somewhat convex. They not unfrequently contain distinct crystals of calcium oxalate as shown at *x*, fig. 3; and occasionally cells filled with raphides may be seen lying on the plates, as at *c*.

But where the *Musa* is not available, good specimens of the diaphragms may be readily obtained from the *Pontederia cordata* which grows in shallow waters everywhere. The petioles which spring from the rhizome consist mainly of sixty or more air-ways with cross plates less than two mm. apart. The flower-bearing stem of this plant has, besides about 150 small air-passages, a large central one in which the ethmoids are about five mm. from each other. After splitting the stem so as to expose this central cavity, one of the plates may be cut loose around the edges and be removed for examination. They are like fig. 3. In almost every transverse section of the stem, ethmoids may be seen in some of the smaller air-ways. And the same is true of the petioles.

Fig. 6 shows a cross section of a *Pontederia* stem of three halves the real size. Fig. 7 gives a short piece in longitudinal section on the same scale. Fig. 8 represents one-sixth of a cross section of ten times the natural size.

Another of the *Pontederiaceæ*, the very prolific *Eichhornia crassipes* (or *speciosa*), which has taken possession of our Southern bayous, abounds in air-passages with ethmoid plates. In one petiole, 380 air-ways were counted. The flower bearing stem, like that of the *Pontederia* has a large central passage in which the partitions are from 6 to 30 mm. apart. Around this central cavity the smaller air-ways are quite as numerous as in the *Ponte-*

deria. There are two forms of petioles, the one short and inflated, the other tapering from the base upwards without special enlargement and reaching sometimes a length of 67 centimetres. Both may occasionally be found on the same plant. The rhizomes and runners by means of which this plant multiplies so rapidly, have a central solid part and, around this, numerous air-ways without diaphragms.

Fig. 9 shows an inflated petiole a fourth the actual size. Figs. 10, 11, 12, 13 give half the real size of successive sections of a tapering one that was 26 c. m. long, 10 being taken at the base and the others at the respective heights of 7.6, 15, and 23 c. m. The diaphragms in *Eichhornia* are like fig. 3, but the apertures are much smaller.

The *Sagittaria variabilis* of the Northern States and *S. lancifolia* of the South have diaphragms of a somewhat different type, the branches of the cells being much more numerous and many of the perforations having a long oval form. One of these plates is represented in fig. 14, enlarged 150 times. It will be observed that of the lines formed by the joining of the cell branches only two abut on each of the oval openings. Fig. 15 shows half the size of a petiole in cross section, taken half way up, in which were counted over 400 air-passages.

The flower-bearing stem of these plants has no large central hollow. In the sheathing petioles of the little *Alisma plantago*, which is of the same natural order as *Sagittaria*, the ethmoids are of an intermediate character, the cells having from six to twelve branches and there being only occasionally an oval aperture between the triangular ones. The flower-bearing stem is hollow and there are some ethmoids in the large cavity.

Of a still different type are the horizontal partitions in the leaves of *Typha latifolia*. Here they are made up of very slender, branching cells and the apertures are relatively large and very irregular in form. These aper-

tures have more commonly four or even five cell joints abutting on them, instead of three. In most of the air-passages there may be found two or more very fine fibre bundles running down through the plates. Excepting these, the spaces between the plates are empty in the upper part of the leaves. But in the lower and sheathing part, the chambers are filled with slender cells branching in every direction, like those in the pith of *Juncus effusus*. The term "stellate" as applied to the *Juncus* cells,* and the figures shown in some of the books are far from giving a correct idea of the actual form. Sections made horizontally, vertically, or obliquely have about the same appearance. Hence the cell branches are quaquaversal instead of being in one plane, and they are quite irregular. This tissue resembles the texture of fine commercial sponge as seen under the microscope. It is spongioid.

The flower-bearing stem of *Typha* is solid. Fig. 16 gives a transverse section of a *Typha* leaf, of the real size.

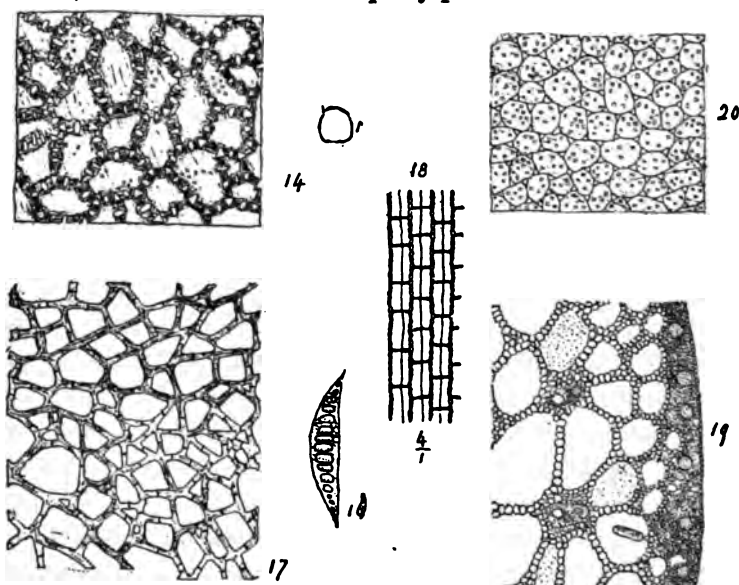
Fig. 17 represents a portion of one of the diaphragms magnified 55 times. Fig. 18 shows a longitudinal of some upper air-passages of about twice the natural size, with fibre bundles running through the chambers. In planes further back other fibres would be seen. They appear as dots in fig. 16.

Diaphragms of a fourth type are found in the petioles, scapes, and spadix of *Peltandra undulata*. In this case the cell division lines run between the angles of the apertures instead of the sides; and so the cells are polygonal and not branching. As this plant is pervaded by a colorless jelly insoluble in water, slices are somewhat difficult to handle. But the slime may be removed by soaking three or four hours in weak ammonia water and then washing with clear water.

* In Engler's new "Das Pflanzenreich" these cells are called "Parenchymstrangen" and the diaphragms "Parenchymrippen," neither of which designations is particularly apt.

Fig. 19 represents a small portion of the *Peltandra* petiole in cross section. Fig. 20 is a view of one of the diaphragms enlarged 75 times. The cells show numerous grains of starch or chlorophyll. *Richardia africana* has the same structure as the *Peltandra*.

The sheathing petioles of *Canna indica* have about 25 air-passages arranged like those of the *Musa*. The diaphragms are from three to six millimetres apart and are thickish and somewhat obliquely placed. The intermedi-



ate chambers are filled with spongioid tissue, and this grows in close contact with the partitions so that it is very difficult to isolate them for examination. The diaphragms themselves are of the *Peltandra* type.

Some of the coarse grasses, like *Zizania*, have sheaths furnished like the *Canna*. Some have diaphragms without intermediate tissue.

The leaves of *Acorus calamus* and the petioles of *Symplocarpus fetidus* have very numerous air-passages with ethmoid diaphragms. Very good examples have been

met within the leaves of some other plants, which however had no flowers or fruit to give a clue to their names. But one of these deserves special mention because the diaphragms are so different from those heretofore described. It is a rush-like plant, probably a *Triglochin*, with very narrow leaves about a foot long and oval in cross section. Here the cell joints are swelled so that, at first sight, they appear like interposed globular cells. The apertures are therefore triangles each of whose sides has a curved indentation.

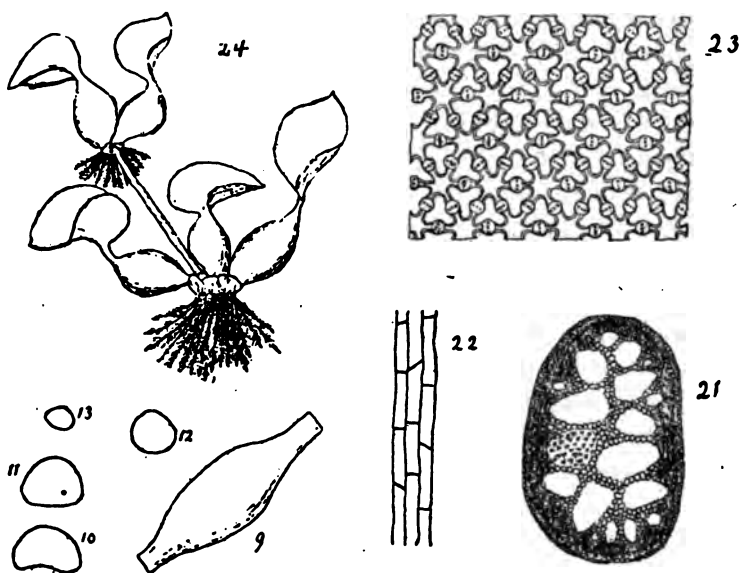


Fig. 21 is a cross section, enlarged 18 times. Fig. 22 shows some of the air-passages and diaphragms on a scale of 7 to 1. Fig. 23 represents part of a partition magnified 175 times. But as this last was not drawn directly from the object, it is a little too regular.

It is evident that in the structure of organs with large air-chambers and ethmoid partitions, considerable firmness is secured with a minimum of solid material. At the same time the free circulation of air in all parts con-

tributes to rapid growth. A banana petiole cut off at the base of the leaf and 42 c m. farther down was found to displace 239 c. c. of water and to weigh 57.5 grams. The net specific gravity was 1.085. Hence there were only 53 c. c. of vegetable matter and sap to 186 c. c. of air. The weight after drying was 5.04 grams. So we have about 1 measure of solid matter to 10 of water and 186 of air. This petiole sustained a leaf weighing 192 grams.

But for lightness the swelled petiole of the *Eichornia* must bear the palm. The one shown in fig. 9, of quarter size, measured 50 c.c. and weighed 4.4 grams. Air-dried, it weighed 0.334 grams. So 11-12 of the bulk was air, and 1-13 of the weight was solid matter.

Air-spaces with diaphragms seem to have some connection with the parallel veining of the leaves. In the leaves of *Iris versicolor* the partitions are not perforated. I have not yet found diaphragms in any dicotyledonous plant. There are four large air-ways in *Nymphaea odorata* and many more in *Nuphar advena*, but here the remarkable, stout, many pointed, distinct cells may act like skewers to keep the parts in place and yet do not interfere with the flexibility. In *Nelumbo lutea* the same office appears to be performed by adherent clumps of calcium oxalate crystals which are purposely distributed along the inner walls of the four large air-passages.

H. S. Newcomb M. College, New Orleans, Oct. 31, 1901.

Catalogues of Microscopes, etc. can be had from ———
B. & J. Beck, Ltd., 68 Cornhill, London.
Negretti & Zambra, 38 Holborn Viaduct, London, E. C.
W. Wilson, 1 Belmont St., Chalk Farm, London, N. W.
Clarkson & Co. 28 Bartlett's Bdgs., Holborn Circus, London, E. C.
W. Watson & Sons, 313 High Holborn, London, W. C.
England.

The Fungi.

GEO. F. MASSEY, F. L. S.

Next to the Phanerogams, or the flowering plants, the Fungi constitute the most extensive group of plants known. Just over 50,000 species are already described, and every year this number is being augmented. In Great Britain are 5,000 species of Fungi, which far exceeds in number that of all other groups of native plants—Phanerogams, Filices, Muscinae, Algae, Lichens—added together.

As in every division of the animal and vegetable kingdoms, the primary groups are indicated by one or two prominent morphological features, which are supposed to indicate a common origin, whereas other and unimportant or secondary characters presented by the group are often very varied. In the Agaricineae, a family including some thousands of species, the common bond of union is the presence of gills or thin plates bearing the spores or reproductive bodies on their sides. The members of this group are popularly known as toadstools, with the exception of the edible species of our pastures, which are dignified by the name of mushroom. The mushroom-eating public flatter themselves that the only fungus they eat is the true mushroom (*Agaricus campestris*). This, however, is far from being the case. *A. campestris* pure and simple is rarely if ever grown by cultivators, but in its place a variety of this species with a brownish more or less scaly cap, known scientifically as the variety *hortensis*. The horse mushroom (*A. arvensis*) is often sold in the London markets as the true mushroom. However, all these are edible, even if lacking in taste and aroma. In this instance "ignorance is bliss."

The uses of Fungi are various. As food products, owing to fear of poisoning, with the exception of the kinds mentioned above, the numerous edible varieties are mostly ignored, except by mycologists. The fungus popu-

larly known as "bluewits" or "bluecaps," however, is often offered for sale. We have at least eighty different kinds of fungi perfectly safe and good to eat. Of these, forty kinds are common and widely distributed, the most abundant and one of the best being the "parasol mushroom" (*Lepiota procera*), one of the toadstool type, having a slender stem five to eight inches in length, and a flat brownish scaly cap six to nine inches across. The gills are persistently white.

The Morels, as they are called (*Morchella*) are amongst the best of edible fungi, and belong to a group of fungi that appear in the spring, when other kinds of edible fungi are absent. The species grow on the ground among grass, the stem is stout, and the cap or spore-bearing portion is globose or conical and marked on the outside with deep irregular depressions. In the Southern Hemisphere the counterparts of our Morels are parasites growing on trees.

There is only one genus (*Cyttaria*), and the species, so far as is known, only grow on the different species of evergreen beech. These southern Morels are not uncommon in Chili and in Tasmania, and were in both countries eaten by the aborigines, as they are at present by their successors. Several species of fungi are eaten by squirrels. Slugs and snails are also partial to some kinds, the poisonous species of *Russula* being especial favorites.

Poisonous fungi do undoubtedly exist, but among the kinds that are at all likely to be collected for food poisonous kinds are not so common as generally supposed. Probably 90 per cent of the deaths caused by poisonous fungi, are due to eating the "death-cup" (*Amanita phalloides*), or its near relation *A. mappa*. Why these fungi should be collected for food is not quite clear. They certainly do not in the least resemble any species usually considered as good for eating—least of all the common mushroom; perhaps it is on account of their neat appearance,

and the absence of anything suspicious in the way of smell or taste that they tempt the uninitiated.

In the majority of fungi the spores are diffused by the wind, but in the most highly organized group (*Phalloideae*) the spores are distributed by insects, which, curiously enough, are attracted by color, scent, and nectar-like food, exactly as in the case of those flowering plants where cross-fertilization is effected by insects. The *Phalloideae* are most abundant in tropical regions. In Britain the group is represented by three species, two of which—the large stinkhorn (*Phallus impudicus*) and the smaller stinkhorn (*Mutinus caninus*)—are fairly common throughout the country, whereas the third, the latticed fungus (*Clathrus cancellatus*) is only met with on rare occasions in two or three southern counties. The smell in all species is very penetrating, and from the ordinary human standpoint intensely disgusting, although not objected to by flies and other insects, which pick up the scent and gravitate in great numbers towards its source, where they find a greenish dripping gluten, very sweet to the taste and containing the exceedingly minute spores imbedded in its substance. This mucus along with the contained spores is greedily eaten by the flies, and by this means the spores are distributed far and wide. In the most highly organized members of the *Phalloideae*, very varied and beautiful contrivances are present, serving as a platform for insects while partaking of their feast. These platforms are so arranged that the sweet mucus, trickling from the cap where it is produced, flows over their entire surface, thus affording standing room for more insects than if the mucus remained on the comparatively small cap.

In one species (*Dictyophora daemonum*) the fungus has a stout erect stalk four or five inches long, bearing at its tip the mucus and spore-producing cap. Springing from the stem just below the cap is a very beautiful network-

structure fashioned like a lady's skirt or rather a crinoline which widens out downwards and reaches almost to the ground. Onto this crinoline the mucus spreads in every direction. In our latticed fungus the portion smeared with mucus is bright red, and resembles a hollow globe having a wall of network, the globe being about three inches in diameter. In other kinds variously branched coral-like appendages receive the mucus.

The subject of parasitic fungi is so extensive that an extended series of talks would be necessary to make clear even the broad outlines of the study, which embraces members belonging to every family of fungi, the individuals varying in size from the ephemeral microscopic mildews and rusts to the large woody structures, resembling inverted brackets, which grow upon and destroy forest trees. The following figures will give some idea of the enormous amount of injury done to the higher plants by parasitic fungi.

In Prussia, according to the Statistics Bureau, the loss on the crop of wheat, rye, and oats, caused by fungi during the year 1891, amounted to \$100,000,000, almost a third of the total value of the crops. In Australia the loss on the wheat harvest of 1890-'91 due to rust was estimated at \$12,500,000. In the United States the vineyards have suffered terribly from the fungus pests. Up to the present time 30,000 acres of vines have been destroyed, causing a direct and indirect loss of 20,000,000 dollars.

These are not exceptional cases, but average illustrations of the disastrous effects produced by parasitic fungi on cultivated crops. Until quite recently these epidemics were accepted with calm resignation, being considered as deserved visitations for wrong-doing. At the present day most civilized countries are establishing experiment stations for the purpose of studying these pests and devising means for checking their devastations.—*Quekett Club.*

Extracts from Postal Microscopical Society's Note-books.

Edited for Science Gossip.

Eristalis Tenax, Longitudinal Section of Halter.—For convenience of examination the halter of the fly may be divided into three separate parts, viz. base, pedicle, and globe or head. On the exterior surface of the base there are three distinct areas or sets of sense organs which have severally an anterior, posterior, and lateral aspect. These have long been considered special sense organs. The lower area is somewhat rounded on the face, and covered with delicate elevations of the epidermis which take the form of circular papillae. They are divided into rows, and between each row there is a line of curved hairs. Lowne states that there are two distinct sets of these lower organs, and Theobald in his work on the "British Flies" has repeated this statement; but in no instance have I met with more than one, and it has invariably a lateral aspect. The two upper organs are placed on opposite sides of the halter, one anterior and the other posterior. They are much longer and larger than the lower one, but like it in having rows of ridges beset with papillae separated by fine hairs. Several sections show the lining epithelium remarkably well. In this place it is especially modified to form a sensory or nerve epithelium. The pointed ends of the cells are seen penetrating the papillae of the lateral organ. The halters receive their rich supply of nerves direct from the second thoracic ganglia. This pair of nerves is the largest in the thorax, and crosses to the opposite side immediately on entering the ganglia. The pedicle is a hollow tube connecting the base of the halter with the globe. On the external surface it is covered with hairs. The interior is divided by a septum which is continued the whole length. A large tracheal vessel passes through it to the globe, where it breaks up into many branches which ramify in the tissue.

Sarcophaga Carnaria, Longitudinal Section of Halter.—

These sections show the vascular tissue in the so-called globe of the halter. In all the halteres I have examined the deep invagination seen in these sections of the globe is invariably present, and there is always a mass of connective tissue extending from the invaginated wall to the opposite wall of the globe. The purpose of the invagination is unknown to me, unless by some means it allows of a certain amount of expansion and contraction of the globe. The large glands most probably secrete a fluid necessary for organs at the base of the halter. The halteres of Diptera doubtless assist in their locomotion, but the evidence of their elaborate structure proves that they have another most important function. The positions of the papillæ are such as to present a front in every direction, and their structure is so delicate as to permit of vibration when sound-waves or other unusual movements of the air impinge upon them. Also the nerve epithelium bathed in fluid secreted in the globe, together with the very rich nerve supply, point to their being rudimentary nerve organs. Otoliths, so commonly found in the Crustacea and Mollusca, I have not met with here, but that does not prove their non-existence. The great number of papillæ (400 to 500) in each halter, and the small number of olfactory organs (two in each antenna) found in many flies which feed on the nectar of flowers, compared with *M. vomitoria* and *M. domestica*, whose halteres carry half the number of papillæ, and in whom the olfactory sense is highly developed, show that the former possess an acute sense to warn them of danger when their heads are buried in the blossoms of the plants they frequent, and that the latter have comparatively little use for such a sense.

Anterior Thoracic Spiracle of Blow-fly.—This spiracle is oval and narrowest above, and is situated between the

pro- and meso-thorax. From the exterior free edge project hollow arborescent chitinous rods, which curve upwards and interlock for about one-third of the length of the spiracle. These rods are hollow, even to the minutest twigs, which have a free opening at their points. Close behind is a transparent membrane, the true valve. It is united to the wall of the large tracheal vessel which extends across the thorax to the opposite spiracle. The free edge of the valve is closely set with a chitinous fringe. A special muscle arises from the integument at the lower end of the spiracle. By the contraction of this muscle the free edges of the valve would be caused to approach each other. From the integument another set of muscles arises, which are directed towards the valve, but whether they are connected with it I have not been able to determine. Antagonistic muscles are a necessary consequence for working the valve.

PROBOSCIS OF BUTTERFLY.—The tongue, or proboscis, is a cartilaginous substance, and owes its great flexibility to being formed in rings, which give it a finely-engraved appearance under the microscope. It is formed of two pieces that can be separated through its whole length, and each being grooved on the inner side they fit together perfectly air-tight; this is effected by an infinite number of fillets resembling the laminæ of a feather which interlace and adhere to each other. Between this groove and the outer skin is a space occupied by tracheæ or the breathing tubes. The proboscis is always carried coiled, but can be uncoiled in a moment. It is perfectly suited to the work of penetrating to the honey of flowers. We know how butterflies close their wings as they alight on a flower, when the insect makes a powerful expiratory effort by which the air is expelled from all tracheæ. At the moment of applying its proboscis to the food it makes an inspiratory effort by which the tube of the proboscis

is dilated and the food ascends at the same moment to fill the vacuum produced, thus passing to the mouth and stomach, being further assisted thereto by the muscles of the proboscis.—*Mrs. W. Major.*

The function ascribed above to the tracheæ is a novel one, and it is difficult to understand how a vacuum can be produced in the œsophagus and its connections by driving the air out of them, even if it were possible. In insects the mouth can only be considered as connected with respiration in the most indirect manner, if at all; for although in certain acari the air-tubes open at the base of the mouth, there seems to be nothing analogous in insects. Respiration in insects is effected by means of two large canals, called "tracheæ," running along the sides of the body underneath the outer surface, which communicate with the air by short tubes called spiracles situate along the sides. I take it that these tubes can never be exhausted of the air they contain, seeing the walls are supported by spirally convoluted fibres, which impart great strength and prevent collapse; and that the air is changed within them, according to the necessity of the creature, by the closing or opening of the spiracles and the continuous rhythmic movement of the body. It may be well to say a few words with respect to the means by which in the Proboscidea the food is drawn up into the stomach. The Hymenoptera, the Lepidoptera, and Diptera are provided with a bladder-shaped distension of the œsophagus which would appear to be a modification of the crop, and is called a "sucking stomach." This is not a receptacle for food, but by its distension and the consequent rarefaction of the air contained therein it promotes suction of the same and facilitates the rising of fluids in the proboscis and the œsophagus, and it is by this means these insects rifle the flowers of their contents.—*E. Bos-tock.*

Notes on Microscopy.

F. SHILLINGTON SCALES, F. R. M. S.

AND H. A. HAIG.

COLORING OF WATER BY MICRO-ORGANISMS.—Much curiosity and speculation have been aroused in the neighborhood of Stoke Bridge, Ipswich, by the turbidity and deep chocolate color of the river Orwell, reaching for some little distance from each side of the bridge. This appearance has been ascribed by some to the scourings of the maltings, by others to spawn, also to the sun, or to the remains of star and jelly fish. This remarkable coloration of the river is in streaks of a greater or less width, and extends but a few inches beneath the surface, whilst on the decline of the sun the color wholly disappears. This phenomenon is caused by countless myriads of beautifully marked plants of a deep chocolate shade. This coloring matter can readily be discharged by chemical reagents and the green structure of the plant rendered apparent, or by the action of iodine the presence of starch can readily be determined. These plants bear a striking similarity in their movements and power of contractility to the fresh water *Euglena*, but in form they resemble a bicuspid tooth, with a deep cleft on each side of the axis. The two fangs might be taken to represent the head, and the crown the base; each plant being about the 1-3,000th of an inch in diameter. Some hundreds of these organisms may be seen gaily disporting themselves in a drop of water scarcely exceeding in size a pin's head, the whole being in a rapid state of motion. These brackish water organisms are delicate, breaking up a few hours after being removed from their habitat. The plants appear to come up with the tide, and are not due to the presence of sewage or other preventable matter.—*Alfred Martinelli, Ipswich.*

BRACT AND FRUIT-SCALE IN CONIFERAE.—The carpellary-

scale in *Pinus*, or *Larix*, corresponds, as is well known, with a carpel in the Angiosperms, but differs in that it is not folded on itself, but is dorsi-ventrally flattened, and bears the ovules upon its upper surface. The bract is a scale-leaf, in the axil, and perhaps partly from the upper surface, of which the fruit-scale arises. The relative arrangement of the xylem and phloem in these two structures is peculiar, and has a distinct physiological bearing upon the question. In the fruit-scale we find that the phloem is uppermost, and adjacent to the under surface of the ovule, whilst the xylem is underneath. In the bract, on the other hand, the xylem is uppermost, lying adjacent to the under surface of the fruit-scale, the phloem being underneath. In this structure, then, the constituents of the bundle have the same relative position as in an ordinary bifacial leaf, whereas in the fruit-scale they have received a "twist," whereby phloem is brought uppermost. That the phloem should lie next the ovules is of importance, for the elements of this tissue merge gradually into those of the nucellus and seed-coat, and there is thus every facility for rapid diffusion of food material during the process of reproduction. Various views are held concerning the manner in which the altered relative position of xylem and phloem is brought about, but these need not be here discussed.

THE STRUCTURE OF THE NUCLEOLUS.—The "definitive" nucleus of *Caltha palustris* offers many interesting points for observation. In the first place, its large size, relatively to the dimensions of the embryo-sac, renders great aid to investigation, as also does the comparative ease with which sections may be made of the sac in the ovules. A longitudinal section of an ovule of *Caltha* at a certain stage prior to fertilization will, if the section be successful and carefully stained with hæmatoxylin, safranin, and toluidin blue, show us all the structures contained in

the embryo-sac. These are (a) the "definitive nucleus," (b) the "synergidæ" and egg-cell at the micropylar end of the sac, and (c) the "antipodal cells," three in number, at the opposite end. In the definitive nucleus we easily make out the nuclear membrane, the chromatin masses, and the large nucleolus. The latter has a well-defined border, and moreover this border is seen to be of fair thickness, and may at certain points be depressed towards the interior, which is clearer. Obviously in this case the nucleolus has the structure of a vesicle, and it is probable that all nucleoli are of this nature, being filled with a clear fluid of an oily consistency.—*Science-Gossip*.

THERMAL DEATH-POINTS OF BACTERIA.—Different species of bacteria vary greatly in their powers of resisting the action of heat. Speaking generally, pathogenic micro-organisms perish at a much lower temperature than non-pathogenic bacteria. Thus the well-known *B. prodigiosus*, which forms a beautiful blood-red colony when grown on moist bread, cannot withstand a temperature of 58° C. for more than ten minutes, whereas the tetanus bacillus only perishes after six hours at 80° C. The bacillus of tuberculosis is rapidly destroyed in cultivations at 70° to 80° C.; but according to Welch, it can resist in the dry state a temperature of 100° C. for three hours. In milk it has been found to perish after four hours at 55° C.; one hour, at 60° C.; five minutes, at 80° C.; and one minute, at 95° C. (Forster). The spores of bacteria can withstand far higher temperatures than the bacteria themselves. Thus the spores of the tetanus and anthrax bacilli are both extremely resistant to heat, though the latter are destroyed by moist heat at 90° to 95° C. This fact is recognized in the sterilization of food products, which are first heated to a sufficient temperature to destroy the parent bacteria, then left for the spores to develop, and again heated to kill the newly-formed bacteria.

As regards the action of heat upon the toxic products of different bacteria, it has been found that some, like the toxin of tetanus, are decomposed and rendered harmless after a short exposure to a comparatively low temperature; whilst others, like the toxine of anthrax, are only weakened and not destroyed at the temperature of boiling water.

MICROSCOPICAL SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.—

October 6, C. Baker exhibited a portable microscope on the model of the "Diagnostic" originally designed for Major Ronald Ross's investigation of malaria. It was made of magnalium, an alloy of manganese and aluminium, and weighs but 14oz. He also exhibited a microscope intended for the examination of fractures and etched surfaces of metals. It is provided with vertical illuminator, rack-and-pinion focussing adjustment and leveling-screws to the mechanical stage, now usual in this class of instrument. Messrs. R. and J. Beck exhibited a portable model of their London microscope, which was a very substantial instrument, and was, by the introduction of several ingenious devices, made to pack with the apparatus into a leather case 2½in. by 4½in. by 9½in. Messrs. Beck also exhibited a centrifuge, made to run at high speed by an electric current. The president brought to the meeting some specimens of the mycetozoa, and gave a brief account of the life-history of this group of organisms. The specimens belonged to a recently-described species, and had been named *Badhamia folucola*, and he had brought some leaves and grass on which were spores for distribution. Mr. C. L. Curties, exhibited a number of mounted specimens of marine zoological objects, accompanied by very full and interesting descriptions. The president gave a *resume* of a paper by Miss A. Lorrain Smith, "On Fungi

found on Germinating Farm Seeds." Miss Smith had been assisting him in his work for the Royal Agricultural Society in examining farm seeds in respect to their germinating power. In the course of their observations, Miss Smith had found numerous species of fungi on the germinating seeds, 14 species in all, of which five were new and one belonged to a new genus. Mr. Millett's report on the foraminifera of the Malay Archipelago, was taken as read. Hon. Thos. Kirkman sent some of the fine quills of the porcupine for distribution among the Fellows, who would find them very useful in mounting minute objects.

DEFUNCT.—Professor C. E. Bessey of the University of Nebraska informs us that the Lincoln Microscopical Club has ceased to hold meetings and that there is no prospect of resuming. If we had the right kind of a National Society which conferred Fellowships upon presidents of local societies, it would be easy to keep these little feeders at work.

NEW PUBLICATIONS.

GAGE'S INTRODUCTION TO MICROSCOPIC METHODS AND HISTOLOGY.

In 1901, the eighth edition of this handbook has been issued. It has now reached 300 pages and 230 figures. This brings it along up towards the size and importance of the first edition of Carpenter. It clearly stands at the head of American works of its class. Indeed we know of nothing to compare with it. Presumably it is primarily a reference and laboratory work for Professor Gage's own students at Cornell. Doubtless it is used as well in the histological classes of many other American colleges. But one can fairly ask why this ground was not long ago taken up by some one at Yale, Harvard or Columbia. Since Gage began, perhaps a dozen years

ago, he has constantly worked up new material and the frequency of editions suggests that the type must be kept standing in Ithaca and a fresh set of proofs sent up the hill very frequently for emendation and expansion. This thrift is very commendable in a constantly changing and growing field of learning. Unfortunately, the old editions quickly outlaw and second-hand copies are worthless.

Comparison with Carpenter is hardly to be thought of, and yet having searched Carpenter's very latest edition for a description of the ever-mentioned "Society Screw," in vain, we turn to page 64 of Gage's Manual and find the formula exactly and properly quoted.

For the general microscopist, we conceive that Carpenter answers every purpose and is indispensable. But for students the price is important. Carpenter costs \$8.00 and Gage perhaps \$1.50. Its data is all easily available through a complete and skillful index.

The frontispiece shows the names of all the 17 parts of a microscope in such a way as to immediately inform a beginner of what the instrument is composed. The other 228 cuts are equally clear and instructive. A dozen or more instruments of different make are shown including both domestic and the better foreign ones. We shall refer later to other matter contained in the book.

MISCELLANEOUS.

ASPLANCHNA.—Several species have interesting jaws and teeth. The jaws are dissolved out with caustic potash and mounted separately. The jaws are from 100 to 150 microns long, (25,000 microns make one inch).

LIQUID AMBER.—Liquid amber *styraciflua* is spoken of as *storax*, *balsamium styracis*, *styrax liquidée* and *Flussiger storax*. It has a high refractive quality. It is used

for mounting diatoms. It always contains a little water which gives it a grayish opacity. This, removed by long standing or heat, it becomes quite transparent. When so dried, it is soluble in alcohol, benzole, chloroform, ether, carbon bisulphide, and volatile oils but not in petroleum ether. When not thus soluble, try xylol and impart a little heat to it. Neither Carpenter or Gage have alluded to it.

STORM EFFECTS.—Maj. H. A. Cummings while in South Africa studied the storms of the Pretoria valley. The air becomes very heated and dry. Storms of severity occurred including whirlwinds of dust, paper, leaves, etc. A nutrient gelatin plate exposed one second in one of these storms developed thousands of colonies of bacteria. The people believed that fever was spread thereby. We may in this way see the power of wind to devastate whole areas of tropical territory.

VACCINATION.—In view of such facts as the following, it is very difficult to see how the persons who are crying down vaccination are actuated by anything less than very blind prejudice.

Jenner's discovery was made in 1798. Prior thereto the ravages of small-pox were simply astonishing, one fourteenth of the population of the earth dying therefrom. In a single year of epidemic in Russia, 2,000,000 persons died of it while many more were made blind or otherwise disfigured. The average annual death-rate in all of Europe was 210,000 by small-pox alone. In Great Britian, the deaths were 40,000 in 1798 but immediately upon vaccination being commenced the deaths decreased to 6,000. In Venezuela, in 1812, Balmi exterminated the disease there; in 1813, a million of people were saved in South America by vaccination. Before Jenner's day, great epidemics of small-pox swept off people like so many flies; since, there have been no epidemics and the uni-

versality of vaccination has rendered it impossible to see what would occur without it.

That rare and occasional accidents have accompanied vaccination may possibly be true. But he who objects on this account is like the man whose store being on fire would not permit water to be thrown in lest some of the goods should get wet!

CARBORUNDUM.—This is silicate of carbon manufactured at the Falls of Niagara by heat produced by a powerful electric current. A wall about 14ft. long, 7ft. broad and 7ft. high, is built up of nuts of coke, faced outside with loose bricks. Along the centre of the wall runs a core composed of ground coke, mixed with sand, salt, and sawdust. A current passed through the core soon heats it up, and burns the sawdust, which leaves the core porous. Next the salt is decomposed, the chlorine in it finding its way to the outside, the sodium remaining behind and uniting with the sand. As the heat increases, the sodium comes off also in a state of vapor, leaving behind the silica of the sand in a state ready to unite with the carbon of the coke. The union produces carborundum in crystals. After long cooling, the wall is thrown down, and the carborundum is extracted. The name is hybrid between carbon and corundum, which has nothing to do with the substance further than that it is half a grade higher than it is in hardness, being inferior only to diamond. It is largely used for polishing granite instead of emery. When pounded and mixed with clay, made into small bricks, and discs, and fired in a kiln, it makes hones of great abrasive power, and wheels which grind down axles or cut through rods of iron.

For Sale.— A Beck stand with three lenses, very little used. Price \$10. Address: G.W. Wilcox, care this office.

THE AMERICAN

MONTHLY

MICROSCOPICAL JOURNAL.

Entered at the post-office as second-class matter.

VOL. XXII. DECEMBER, 1901. NO. 12.

CONTENTS.

The Ehippium of Bosmina. Scourfield.....	311-317
On the Resolution of Amphipleura Pellucida with a Dry Lens and Axial Illumination. Merlin.....	317-323
Larval Water-mites on Aquatic Animals. Soar.....	323-324
Viewing Diffraction Spectra. Reinberg.....	324-325
Sketch of J. D. Whelpley.....	325-328
A Murder Trial in Washington.....	329-330
NOTES ON MICROSCOPY. M. I. Cross.—The Microscopical Examination of Metals; Multiplied Images in Diatoms.....	330-332
Terms of Subcription for 1902.....	332

The Ehippium of Bosmina.

D. J. SCOURFIELD.

ILLUSTRATED.

The production of winter or resting eggs in the genus *Bosmina* has been referred to by various writers on the Entomostraca, but I do not think that any description of the egg's protective covering, which corresponds, of course, to the ehippium of the *Daphnidæ*, has hitherto been published. As this structure exhibits one feature at least which distinguishes it from the homologous productions of all other forms of the Cladocera, it appears worth while to bring forward the present short paper on the subject.

If we examine the recently thrown-off resting eggs of *Bosmina longirostris* enclosed in its protecting case (fig.

1), we shall see at once that the latter is only a portion of the carapace of the mother. The particular part of the shell which has been utilized for the purpose evidently consists of the valves (as distinguished from the head-shield), with the exception of a rather large piece of their ventral margins. The ventral margins have not wholly disappeared, for the characteristic shell-spines at the posterior ventral angle are still present. At first sight it does not seem that the portion of the shell now enclosing the resting egg has been specially modified. The ordinary faint hexagonal markings on the surface of the valves are quite apparent, and the valves themselves are as transparent as when forming part of the coat of the living animal. Towards the back there is, it is true, a somewhat darker tinge than usual, but this is not very noticeable, and taken by itself would scarcely suggest special modification. Looking more closely at the structure, however, it will be seen that at the back—i. e., along the line representing the dorsal margin of the original valves, there is a distinct increase in the thickness of the chitin, and, further, that there is a narrow, highly refractive band of chitin running somewhat obliquely across each valve from near the anterior dorsal angle to within a short distance of the posterior margin. It is the possession of these lateral thickened bands of chitin which distinguishes the ephippium of *Bosmina* from all homologous structures.

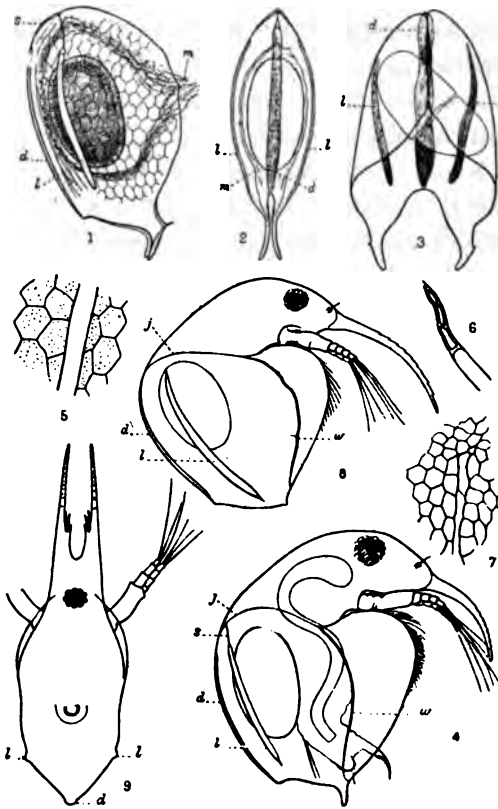
If one of the lateral bands of chitin be still further examined, it will be seen that it probably represents a modified line of hexagonal areas, forming part of the shell sculpture of the unaltered valve. But all the cross partitions have been obliterated, and the edges of the band have been smoothed so as to show but little indication of the original polygonal arrangement. The extremely minute granulation or pitting of the areas enclosed by the shell markings has also disappeared, for the chitin

of the band seems absolutely homogeneous (fig. 5). In continuation of the band anteriorly, there is a slit in the valve which runs up to the anterior margin near the anterior dorsal angle. The edges of this slit are normally in contact, but may be easily separated by pressure. The slit seems to be produced by the falling out of a number of pieces of chitin (fig. 6), exactly in the same way as I have described in the case of the line of separation along the ventral edge of the ephippium and round the valve margins in *Leydigia acanthocercoides*. The pieces of chitin no doubt represent modified hexagonal areas of the original shell sculpture in the same line as the series which produce the lateral band. In connection with this it may be pointed out that the anterior end is often seen to be separated from the rest of the band by a transverse line (fig. 1). At its posterior end the lateral chitinous band appears to end abruptly in the ordinary shell markings.

In *Bosmina longirostris* the lateral bands do not project very much beyond the surface of the shell, but in a species (fig. 8) from Upper Lough Erne (probably *Bosmina lilljeborgi* Sars, although this is perhaps only a variety of *B. coregoni* Baird), very kindly sent to me by Mr. W. F. de V. Kane, the projection of the lateral bands is so pronounced that they deserve to be termed ridges (fig. 9). The position of the bands in this case is also a little different to what it is in *B. longirostris*. As will be seen by a comparison of fig. 8 with fig 1 and 4, there is a rather greater distance between the lateral bands and the back of the shell in *B. lilljeborgi*(?) than there is in *B. longirostris*; and more important still, the lower ends of bands approach very much nearer to the posterior ventral angle of the shell in the former than in the latter species. I may mention here that the lateral bands are not always so evenly curved as shown in the figures, but that they sometimes exhibit rather abrupt bends—as if in

their formation the deposition of chitin had not followed one line of cells the whole way, but had changed from one series to another.

As regards the function of the lateral bands, I would suggest that, in addition to strengthening the ephippium



as they evidently do from their position almost directly over the egg, they may also help to keep the free edges of the valves more closely in contact than might otherwise be the case. Such a result would certainly follow if the ends of the bands, by their elasticity, possessed the power of pressing inwards and carrying the free margins

of the valves with them. I do not know whether such a tendency exists, but it is at least very probable.

In addition to having the lateral bands very strongly marked, *B. lilljeborgi*(?) also shows the thickening along the back as a distinct ridge (fig. 9). That the dorsal thickening is really in the form of a sharply defined band can however, be also seen in *B. longirostris*, when views can be obtained either from the front (fig. 3) or back (fig. 2).

There is still one other point requiring elucidation, namely, how is it that the ventral portions of the valves become detached when the shell is to form an ephippium? By very careful scrutiny of a female carrying an ephippium and winter egg (figs. 4 and 8). It can be demonstrated that there is a line of weakness, marked by a faint doubly-contoured line on each valve already formed in the exact position where the anterior portion will break away. This line of weakness can be developed into a crack, at least for some portion of its length from the anterior end, by applying pressure. The edges of the crack are quite smooth. The line of weakness does not cross any of the

EXPLANATION OF PLATE.

Fig. 1. Ephippium of *Bosmina longirostris*, side view $\times 150$; Fig. 2, dorsal view $\times 140$; Fig. 3. front view (somewhat flattened out of shape), $\times 140$.

Fig. 4. *Bosmina longirostris*, carrying ephippium and winter egg, $\times 130$.

Fig. 5. A portion of a lateral band of chitin, with adjacent shell-markings (ephippium of *B. longirostris*), showing how the areas enclosed by the latter are pitted, whilst the band is structureless, $\times 350$.

Fig. 6. Upper portion of a lateral band (*B. longirostris*), showing the loose pieces of chitin at its anterior end, which apparently fall away and produce the slit found in this position in the ephippium, $\times 280$.

Fig. 7. Portion of shell culture of a specimen of *B. longirostris*, showing probable early stage in the formation of the line of weakness between the ephippium and the ventral portions of the valves, $\times 180$.

Fig. 8. *Bosmina lilljeborgi* (?), carrying ephippium and winter egg, $\times 90$.

Fig. 9. *B. lilljeborgi* (?) view from above, showing the projecting lateral and dorsal bands of chitin, $\times 110$.

ordinary shell markings on the valve, but, from the relation of the latter to one another on each side of the line it is evident that a considerable amount of alteration of the original shell sculpture has taken place. The probability is that a line of hexagons has been suppressed or rather completely modified to form the line of weakness, and this view is borne out by the arrangement of the shell markings shown in fig. 7, where we seem to have a very early stage of the process exhibited. The one long cell, which lies exactly where a portion of the line of weakness is always developed, has plainly been formed from the ordinary hexagonal markings, because its edges show the characteristic zigzag arrangement, and the crossbars are also just discernible, although almost obliterated. It is somewhat strange that in the specimen from which this was drawn there was no trace of any modification having commenced for the production of the lateral bands and slits. It looks as if the production of a line of weakness may be older in the history of the development of these ephippia than the formation of the lateral chitinous bands. This may very well be so, because among the Lynceidæ, where there is in many cases scarcely any actual modification of the shell, there is almost invariably a line of weakness developed prior to the moulting of the ephippium.

Having now seen how it is that the ventral portions of the valves become so easily detached from the rest of the shell when an ephippium is formed, we may very well ask ourselves why this process should take place. As the phenomenon is so common among the Cladocera there must be some fundamental necessity for it. I think the answer to this question is undoubtedly to be found in the fact that in the vast majority of cases it would be quite impossible for the anterior margins of the valves to be brought into contact if the ventral, and especially the anterior ventral portions of the valves, owing to their

very convex nature, remained in position. In other words, it would be impossible for the ephippium to form a closed covering for the egg.

In addition to the outer protective covering which has just been described, there are also some very delicate inner membranes which surround the egg, as indicated in fig. 1. They most probably consist of the moulted inner layer of the shell valves, and, so far as can be seen, do not appear to have undergone any special alteration. The resting egg itself—there is never more than one in any ephippium—is very largely composed of small globules of a dull greenish oily material. At the edges it is slightly translucent, but elsewhere opaque. It can readily be distinguished from a “summer” or parthenogenetic egg by its rather larger size and general opacity. Of course it is enclosed in a special covering of its own, the egg-shell properly so-called. In fig. 3 a broken egg-shell is shown, inside its protecting ephippium, after the hatching out of the young *Bosmina*.

It will be apparent from the foregoing description that the ephippium of *Bosmina* much more nearly approaches the homologous structures found in the majority of the Lynceidæ than it does those of the Daphnidæ. It is, in fact, scarcely worthy of the name of an ephippium, as that word is commonly understood, but would be more correctly designated as a proto-ephippium, a term I have already employed for these less highly developed types of protective egg-coverings.—*Quekett Club*.

On the Resolution of *Amphipleura Pelleucida* with a Dry Lens and Axial Illumination.

A. A. MERLIN, F. R. M. S.

Many members of our Club have been long familiar with the structure of *Amphipleura pellucida* as revealed by oil-immersion objectives of the highest class and aper-

ture. The point to which I now beg to call your attention is the accomplishment of the resolution of normal specimens of this diatom by means of Zeiss's dry 4 mm. apochromat, and 5-6ths solid axial cone from Powell's adjustable apochromatic condenser.

I was led to attack the *A. pellucida* with the above specified optical arrangement through having remarked the great strength of the resolution yielded by some realgar-mounted specimens under the Zeiss 3 mm. of N. A. 1.4 and a solid axial cone of about N. A. 1.2 from an oil-immersion condenser. I must confess that the exact theoretical resolving limit of an object glass of N. A. .95, as given in the table on page 85 of Carpenter's "The Microscope and its Relations" (Seventh Edition, Edited by Dallinger, 1891), had at the time escaped my memory, otherwise it is extremely improbable that any such attempt would have been made.

It was found, however, that in actual practice the 4 mm., used in conjunction with a 27 compensating ocular, with which eyepiece the image remained perfectly sharp, would steadily show the fine transverse striae on realgar mounts, although the lineation was much fainter than that revealed by oil-immersion lenses of large aperture.

The resolution of valves in realgar having been accomplished, dry and balsamed specimens were next examined, and to my very considerable surprise, both proved resolvable with the 4 mm. and 5-6ths axial cone. In balsam the striae appear as extremely faint, but clean, grey lines of great fineness. Although most faint and difficult, they have been held with perfect certainty for short intervals, slightly averted vision proving of material assistance in this instance.

In order to satisfy myself that the true striae are indeed rendered visible by the 4 mm., a valve has been first arranged to exhibit them under the lens, an oil-im-

mersion being afterwards substituted, when the lines have been found to be identical, and of the same fineness and distance apart with both objectives, the only difference being in the strength of the resolution afforded by them.

The significance of the above results is at once apparent on turning to the aperture table, where we find that N. A. .96 is given as the *limit* of resolution of the *A. pellucida*; hence it would appear that the Zeiss 4 mm. of N. A. .95 (nominal), illuminated by a 5-6ths solid axial cone, is in practice capable of revealing structure just within the theoretical resolving limit of a lens of N. A. .96, and also that this resolution is attainable not only in media of high refractive index, but also in balsam and with dry mounts.

Now the 4 mm., although its guaranteed minimum N. A. is only .95, as a matter of fact is quite likely to possess a N. A. of .96, or even one slightly in excess of this, so that theoretically, without any deduction for technical imperfections, it would be just capable of resolving the *A. pellucida*; but that this theoretical limit should be actually attained by a lens with strictly axial illumination, and on specimens mounted in media of both high and low refractive index, cannot but be regarded as a very extraordinary and interesting result, it having been hitherto considered that the transverse striae of the *A. pellucida* are in actual practice only just discoverable with the dry achromatic lenses of N. A. 1.0, and that only on specimens mounted in a medium of about 2.4 refractive index when illuminated by oblique light in one azimuth along the valve.

Perhaps not the least interesting and satisfactory outcome of these observations is the indication that a dry lens is capable of working to its full theoretical capacity on balsam-mounted objects, the resolution only becoming more conspicuous in media of higher refractive index.

In addition to the *A. pellucida* many other forms have

been recently studied with the 4 mm. and a 5-6ths solid axial cone. The most difficult structural features have not been seen with a lesser cone, but I do not assert that they may not possibly be so resolved, although the results of my observations have strongly inclined me to the belief that, with axial illumination, structure just within the capacity of the lens employed can only be seen with a very large cone. It has appeared to me that closing down the cone, while greatly strengthening the contrast of the coarser, causes the finer detail to disappear altogether, and materially reduces the separating power of the objective. With reference to this matter the following experiment may prove interesting:—Arrange a Cherryfield *Navicula rhomboides*, mounted in a mixture of monobromide of naphthaline and balsam, under a good semi-apochromatic $\frac{1}{4}$ " of N. A. .77, and 27 ocular, so that the valve shall lie longitudinally along and on the sharply focussed edge of the lamp flame. With slightly under $\frac{1}{4}$ cone the longitudinal striae will appear conspicuous throughout the entire length of the valve, while the closer transverse striae, although they may be seen to a certain extent, are far less satisfactorily defined, no thoroughly clear separation being apparent. Now replace the smaller by a 5-6ths cone. The coarse strongly-defined longitudinal striae disappear, and at the first glance all structure may seem to have disappeared with them, but a little careful scrutiny will reveal the presence of a faint dotted resolution, the transverse divisions of which are as fully and cleanly shown as the longitudinal.

I am aware that the results dealt with in this paper can not meet with general acceptance until they receive confirmation at abler hands than mine, nor indeed would it be desirable that they should be so accepted, involving as they do important theoretical considerations, until independent practical experience shall have placed their truth beyond doubt.

The subjoined notes on some of the forms lately examined with the 4 mm. may be of interest. A very large central solid cone has been invariably employed in conjunction with either Gifford's or the beautiful new acetate of copper screen.

Nitzschia curvula Sm. This diatom is mounted next to *Amphipleura pellucida*.

Grun. Moller's balsam type slide. Transverse striae extremely faint and difficult. A delicate object even with N. A. 1.3 and 1.4.

Nitzschia linearis and *N. obtusa* Sm. In balsam. The former very faintly resolved into transverse striae, the latter not so difficult. Dr. H. Van Heurck, in his "Synopsis des Diatomees," gives *N. linearis* as having 27 to 30 striae in 0.01 mm. (25.399 mm. = 1 inch), and *N. obtusa* 26 to 27 in 0.01 mm. *N. sigmatella* Grun., is given at 25 to 26 striae in 0.01 mm., but the specimen of this form on the type slide has much finer structure than *N. linearis* and *N. obtusa*.

Nitzschia sigmoidea Sm. Moller's dry "Probe-platte"—25½ to 26 striae in 0.01 mm. according to Van Heurck. This is remarkably easy with the 4 mm., the striae presenting a beaded appearance. They can be certainly seen with the 12 mm. apochromat of N. A. .65, so do not probably, in this instance, exceed 55,000 to the inch. A specimen in balsam is also very easy with the 4 mm.

Nitzschia sigma Sm. Van Heurck gives 22 striae in 0.01 mm. Distinctly dotted in balsam, and very easy in mixed monobromide of naphthaline and balsam.

Grammatophora oceanica Ehrenbg.—*G. subtilissima*. Moller's dry "Probe-platte." Resolved into transverse striae. Van Heurck gives 30 striae in 0.01 mm. for the *G. oceanica* var. *indica* Grun., and 30 to 31 for the *G. oceanica* var. *novaezeelandiae* Grun. Some specimens of *G. subtilissima*, however, are finer, running at about 88,000 to the inch.

Navicula crassinervis. Striae 34 to 35 in 0.01 mm. according to Van Heurck. This has proved a most delicate object with the 4 mm., both dry and in realgar. With N. A. 1.3 and 1.4 realgar mounted valves are sharply resolved into dots, but the transverse striae have alone been seen with the dry lens.

Hyalodiscus subtilis. In a mixture of monobromide of naphthaline and balsam. Dotted structure on outer zone well seen, although faint and difficult near the edge of the disc. In balsam mounts the structure appears still fainter, but nevertheless may be traced nearly to the outer edge, where it runs at about 76,000 to the inch.

Surirella gemma Ehrbg. In realgar the beading has been seen beautifully defined with the valve arranged longitudinally on the sharply focussed edge of the lamp flame. Specimens mounted dry, in balsam, and in quini, dine, have been also examined, but their complete resolution has proved a much more difficult matter.

Colletonema vulgare. Moller's balsam type slide. This has been most carefully studied with the 4 mm. The resolution is very faint, and requires particularly exact focal adjustment, but when once seen it can be held fairly steadily without any great difficulty. Dr. Van Heurck writes of this diatom, "Stries fines, delicatés, les moyennes faiblement radiantes, les terminales parallèles-environ 34 en 1 c. d. m.; les stries medianes plus fortes, plus écartées, 24 en 1 c. d. m. et plus radiantes."

Navicula major. Moller's balsam type slide. The full resolution of the structure of the bands on the hoop of this diatom is by no means easy, even with the Zeiss 3 mm. apochromat of N. A. 1.4. Notwithstanding this, the resolution is carried very far by the 4 mm., the striae appearing remarkably black, crisply defined, and well separated, their beaded nature being quite recognizable, although not so fully revealed as with the oil-immersion. On this specimen the striae alone are just visibly separat-

ed by the 12 mm. apochromat, 5.6ths axial cone, and a Huyghenian eyepiece magnifying about 45 times, the 27 compensating ocular not proving sufficiently powerful for the purpose with this objective.

Larval Water-mites on Aquatic Animals.

C. D. SOAR, F. R. M. S.

In a paper on Hydrachnidae, read in 1896, (*Journ. Q. M. C.*, Vol. VI., p. 318), I mentioned that I wished to make myself familiar, as far as possible, with the larval forms of water-mites, and by a systematic search among all kinds of our pond-life to find out upon what creatures these larvae occurred, and if the same species was always parasitic on the same host. Since then I have collected and examined a great many aquatic insects, etc., but the results so far have been rather poor. They have, however, been considered sufficiently interesting to put on record.

One of the most common aquatic insects upon which to find the larvae of Hydrachnidae is *Coriza geoffroyi*. I have found a great number of these, and some of them I have succeeded in keeping alive long enough to allow the red globular water-mite larvae to drop off and become free-swimming. The latter always turned out to be the nymphs of one of the species of the genus *Hydrachna*.

In September, 1898, on the Norfolk Broads, I took a number of water-boatmen, *Notonecta glauca*, afflicted with the red globular parasites. I brought some of them home, but, although I kept one or two alive for a long while, I did not succeed in getting any of the larvae to arrive at the next stage. In the spring of 1899, I again paid a visit to the same neighborhood, and succeeded in capturing some more water-boatmen. A number of these were brought home alive, as before, and this time I was successful in getting some of the red globules attached to the legs and body of the water-boatmen to become free-swim-

ming in the nymph stage. These again all turned out to be a species of the genus *Hydrachna*. By comparing the size of the red larvae found on *Notonecta glauca* in the autumn of 1898 with those found on the same form at the same spot in the spring of 1899, I have come to the conclusion that the water-mite larvae remain attached to their hosts for a whole season—namely, from the summer of one year until the spring of the next—and the fact that those I found in the autumn did not undergo any alteration helps to strengthen this opinion.

I have further found two small yellow pear-shaped larval water-mites on the larval form of a gnat, and also one on an *Ephemera* larva, but I have been unable to rear them.

I have found also that the water-scorpion, *Nepa cinerea*, is a favorite host with some species. But I have not been able to keep any alive long enough to find out to what species of water-mite the larvae belong. In Epping Forest I took a specimen of *Ranatra*, literally covered with red water-mite parasites of all sizes. This I succeeded in keeping alive until ten specimens became free-swimming. They all turned out to be nymphs of *Hydrachna globosa* Geer. But the most curious find, perhaps, in this connection, has been a small fish from a pond on Earlswood Common with two larval forms of water-mites attached, which I take to belong to a species of *Arrenurus*. *Quekett Club*.

Viewing Diffraction Spectra.

J. REINBERG, F. R. M. S.

It is a matter of common knowledge that the diffraction spectra, which an object under the microscope gives rise to, may be observed by removing the eyepiece and looking down the tube. But unless the eye is kept perfectly steady, which is difficult, they shift and change about. For this reason Dr. Johnstone Stoney recommended look-

ing at them through a pinhole near the eyepiece, a method which I followed for some time. This, though it does away with the shifting, reduces the light very much. It is also possible to view the spectra by screwing an objective into the lower end of the sliding draw-tube, with eyepiece in position at the upper end, and then focussing down on to the upper focal plane of the objective, but this is a cumbersome business. Latterly I have employed a method which is exceedingly convenient and efficient. The diffraction spectra, as is known, are not only formed in the focal plane of the objective, but are reformed just above the eyepiece, and may there be viewed by means of a lens. So I have mounted in a short tube the objective of one of the cheap toy microscopes, which is in effect a lens of about a $\frac{1}{4}$ inch focus stopped down to an actual aperture of about 1 mm. The diffraction spectra ocular, as we may call it, when placed on the ordinary eyepiece of the microscope, on the cap of which it fits shows the spectra splendidly, magnifying them at the same time. It gives plenty of light, and the spectra can not shift. I can strongly recommend the arrangement to those who cultivate the useful habit of studying the spectra, *i. e.*, the optical effect produced by an object, as well as the object itself.—*Quekett Club*.

Sketch of J. D. Whelpley.

Born at Battle Creek, Mich., May 24th, 1861, Dr. Whelpley has just turned 40. To enumerate even the larger portion of the things which he has done during the comparatively few years of his existence would fill a volume, so no attempt will be made in this slight sketch to touch his career except at the high places. To show the strength of heredity it may be well to state in the first place that the subject of this notice is descended from a family of physicians, his father, grandfather and great-grandfather having practiced

medicine. From his maternal side, the Doctor inherited a love for literature. His mother's family produced many politicians, his maternal great-grandfather having been one of the framers of the constitution of Wisconsin, the inkwell from which that famous document was written being now in the Doctor's possession. This ancestor was once a candidate for governor of Wisconsin, on the losing side. The



famous Salmon P. Chase was a relative of Dr. Whelpley's mother.

Young Whelpley's education was aquired in the schools of his native state, including the college at Otsego. When hardly more than a boy he tried his hand at teaching a country school, with what success may be judged from the act that he is yet a teacher. Before moving to St. Louis in

1881 to take advantage of the opportunity presented by the city to acquire a college education in pharmacy, the future president of our leading pharmaceutical organization had received his first instructions in bottle washing and window cleaning in Michigan, and had also practiced pharmacy in Illinois.

Applying himself to his studies with his usual diligence, the student was graduated by the St Louis College of Pharmacy in 1883 with the highest record which had been made at that institution up to that time, and won the gold medal for general excellence. While at college his irrepressible predilection for teaching compelled him to form a quiz class—the first in the history of the college—of which he was master. Upon his graduation he became a regular quiz-master of the college and has continued his connection with the teaching faculty ever since, being now professor of microscopy.

When but sixteen years old, Mr. Whelpley began to read medicine, but did not go about it seriously until many years later. In 1890 he was graduated by the Missouri Medical College, ranking third in a class of 117, notwithstanding the fact that he was looking after outside interests while carrying on his studies.

Five years before he had gained his degree of M. D. Dr. Whelpley began to teach in the medical college mentioned. After his graduation he became a member and secretary of the faculty. For ten years he filled the chair of histology, physiology, and microscopy, and then, upon the merging of Missouri and St Louis Colleges into the Washington University, he became, and still is, professor of materia medica and pharmacy in the latter. He is also professor of the same two branches in the dental department of the university. The Doctor, or Professor, as he should be known in this connection, has a faculty of being able to impart to his students any knowledge he possesses. He is popular with the boys, and is able to be on the most friendly terms with-

out in any degree losing any of his own or of their respect.

In addition to his other work as a teacher the Doctor delivers free popular lectures on scientific subjects during the winter.

This many-sided man under discussion is a member of the American Medical Association, as well as of his state and city societies, and also of the local Academy of Science, and Historical Society. He was a delegate to the Pharmacopœial Convention in 1890, and again in 1900, being elected secretary of the convention the latter year. He is also active in the alumni associations of the colleges of which he is a graduate, and is well up in Masonry and Odd Fellowship.

The literary work of the new president began when he was young. He acted as correspondent for the newspapers while still a boy, and also edited a college paper. Soon after going to St. Louis he became the pharmaceutical editor of the St. Louis Druggist. The paper became the National Druggist, and he became the editor. In 1890 he left that paper and assumed entire charge of Meyer Brothers Druggist a position which he still holds. He has published Curtman's Lecture Notes, and Whelpley's Therapeutic Terms. His contributions to the statistical knowledge of the use of the metric system have been large.

In 1892, Dr. Whelpley and Miss Laura Spannagel, the daughter of a well known St. Louis banker, were married.

While making no public pretense to scientific attainment Mrs. Whelpley took a post-graduate scientific course at Cornell and is well versed and much interested in her husband's work. Their pretty home is a veritable museum of archæology and microscopy. In it is a large library of microscopical works, about 8,000 rare microscopical specimens, a large and unique collection of Indian relics and like historic and prehistoric things. This home is open to students of science, some coming from Europe to visit it and see archæological specimens which cannot be duplicated in any of the museums of the world.

A Murder Trial in Washington.

A Mrs. Bonine is on trial for the alleged murder of James Seymour Ayres in his bed-room at 2 o'clock one morning last May. She admits that she alone was with him at the time of shooting, but claims self-defence. Curiously, it is to her interest to prove blood on her garments to an extent that will show that there was a hand to hand struggle. Her expert, Dr. Sterling Ruffin, testified as follows:

Q. What are the principal tests for blood spots?—A. There are three tests in particular—the Wyeth, microscopic, and Haeman-crystal tests.

Q. Are all in vogue at the present?—A. Yes, sir. All are in vogue and are recognized by the scientific world as reliable.

Q. Are they all conclusive?—When applicable; yes, sir.

Q. Did you make any experiments as to whether there was any blood on Mrs. Bonine's wrapper?—Yes, sir.

Q. Where?—A. In Dr. Schaeffer's office.

Q. Who was present?—A. Dr. Schaeffer and Dr. Carroll at one time and Dr. Schaeffer, Dr. Carroll, and yourself at the other time.

Q. Did Dr. Schaeffer observe the experiment?—A. Yes, sir.

Q. What did you find regarding the condition of the wrapper?—A. I found several rips and tears.

Q. Did you inflict or enlarge any of these?—A. No, sir; not by the fraction of an inch.

Q. Did you examine the wrapper for blood spots?—A. Yes, sir. I took pieces of the wrapper from several places for the purpose of examining them.

Q. Where from?—A. I took one piece from the front and one from the back of the lining of the green velvet yoke and various other specimens. Some consisted of the velvet and some of the brown material of the wrapper.

Q. What was the result of your examination of the two specimens taken from the yoke?—A. I found blood on both.

Q. What tests did you use?—A. I used the Wyeth, microscopic, and Haeman-crystal tests.

Q. What did they show?—A. Each showed there was blood on both specimens.

Q. Were all of the tests applicable and conclusive?—A. Yes, sir.

Notes on Microscopy.

M. I. CROSS.

THE MICROSCOPICAL EXAMINATION OF METALS.—It is a little singular that a study which has assumed such great importance as the examination of steel and iron under the microscope has done during recent years should not have received any treatment whatever in so exhaustive a work as the new edition of "Carpenter on the Microscope." It is a highly technical and important subject and has become an absolute essential in all iron and steel works. In fact, there is probably no factory of standing that is not equipped with suitable instruments both for observing and photographing.

Although much information regarding the chemical constitution of the metal is disclosed by the microscope, it is in ascertaining the mechanical properties that the special value of the examination lies.

For instance, the structure of steel varies with the different degrees of hardness and the amount of heat to which it has been subjected, and it is possible to gain definite information concerning the suitability of the metal for the purposes for which it is to be used by means of the microscope.

In the manufacture of guns the microscope is invariably resorted to, and it can be definitely determined before the manufacture is proceeded with whether the metal is suitable for the purpose, or any defect has taken place in the heating or quenching which would render the gun unsafe or unsatisfactory.

Engineers can detect flaws, blow-holes, defective welds, etc., and in many ways are able in an early stage to avoid the trouble incident to the use of imperfect metal in the finished article. Microscopes for the exclusive purpose

require no substage apparatus or mirror, and although the completed stand is usually employed, the demand has become sufficiently marked for makers to produce special instruments in which a large mechanical stage is provided, but no fittings beneath the stage. Among these are Reichert, of Vienna, C. Baker, of London, and Queen, of Philadelphia. In all of these the vertical illuminator plays an important part; some observers preferring the pattern with a prism, others the cover-glass reflector, while many employ both, finding that each pattern is advantageous according to the structure examined.

When the light and illuminator have once been adjusted, it is important that no movement of the body of the microscope takes place, or the illuminating would have to be re-set. To obviate this, these special microscopes by Queen and Baker have rackwork focussing adjustment to the stage, together with levelling screws, so that any want of parallelism in the piece of metal may be corrected, and the face set at right angles to the plane of the objective. It will be seen from this that the subject has received careful consideration, and that suitable means are available for accurate work.

The metals themselves that are to be observed have to be prepared with great care; the processes are technical, and vary with the purpose of the examination. Generally a small sample block is taken, and cemented to a piece of glass. It is then ground and polished on a series of emery papers, and finally with a very fine polishing material such as rouge, until no scratches can be detected.

Although the harder portions can be in many instances seen at this stage, chemical means have to be resorted to, to differentiate the structure, the action being unequal on the different constituents, and it is by the treatment with such chemicals—nitric acid and liquorice juice being among the most important—that the chemical composition is detected. Many of the constituents have received distinctive names, among them being:—

Ferrite, which is the name given to pure iron.

Cementite, representing the iron carbide in steel.

Pearlite, a mixture of cementite and ferrite.

Martensite, the structure of quenched steel.

Austenite, a name given to structure which is produced in steel in which there is a high proportion of carbon.

There is vastly more to be learned of this interesting subject, and it is a field in which the amateur could with interest and profit make investigations.

MULTIPLIED IMAGES IN DIATOMS.—Happening to hold a needle over the mirror of the microscope while a slide of *Triceratium* was under examination, I noticed that its point appeared dimly in each of the interspaces, and on racking the body of the microscope slightly upwards in same manner as is necessary when observing multiplied images in the cornea of the eye of a beetle, I noticed that it became distinctly sharp. I then placed a piece of black paper cut in the shape of a cross on the mirror, and with a 1-6 in. objective saw it sharply displayed, although on a much smaller scale than in the eye of beetle.

Experiments were then made with *Coscinodiscus* and other diatoms, and the same result was shown. This would seem to indicate that these interspaces are lenticular in shape, and it may be that with this knowledge further light may be shed on the complex question of the ultimate structure of some of the *Diatomaceæ*.

Subscriptions for 1902

The published price of this Journal for 1902 will be \$1.20. From this, a discount of twenty cents will be made for prepayment coming from the subscriber direct or through any agent or intermediary the subscriber may select. Whenever we have to send bills we shall charge the published price \$1.20. We prefer not to deal through middlemen and therefore cannot hereafter, as many periodicals do, make a larger price in order that middlemen may get their allowances. We wish to net a dollar in advance without discount or trouble of sending bills and cannot put a premium on round-about methods which benefit neither the subscriber or the publisher. Yet as "agents" will be used and if used ought to be remunerated we publish the price at \$1.20 and so authorize them to charge that price. Out of it they must remit to us one dollar.

INDEX

- Abbe, Professor, 259
 Actinocyclus, 44
 Actinomycosis, 24
 Adjustment, 168
 Agar-agar, 35
 Agaricus, 295
 Alcyonium, 19
 Alga, 119, 144, 177, 220, 243
 Amber, 308
 Amphipleura, 87, 124, 265, 317
 Amphiprora, 278
 Anchylostoma, 91
 Antedon, 19
 Antennae, 109
 Arctic bacteria, 22
 Argulus, 230
 Arsenic, 154
 Arthritis, 23
 Asplanchna, 308
 Astrology, 150
 Atoms, 206
 Aulacodiscus, 273
 Auto-intoxication, 43
 Bacilli, 162, 187, 204
 Bacteria, 1, 22, 30, 85, 107, 174, 205, 305, 309
 Bartow, Edward, 152
 Bastian, Dr. 5
 Beetles, 195
 Blood exam. 112, 138, 202, 245
 Blow-fly, 300
 Bone, 177
 Bosmina, 311
 Boston, L. N., 91, 112
 Botany, 89, 150, 180
 British instruments, 159
 Brownian movement, 85
 Bubonic plague, 31, 43, 85, 183
 Burbidge, W. H. 19
 Burton, Jas. 241
 Butter, 116
 Butterfly, 301
 Camera lucida, 30, 255
 Canada balsam, 80, 117
 Cancer, 102
 Carborundum, 310
 Carmine, 233
 Carpenter, 250
 Cell-contents, 228
 Cells of glass, 13
 Cement, 203
 Centrosomes, 174
 Chemistry, 59
 Coal, 207, 235
 Colon bacillus, 27, 51
 Collodion, 106
 Condensers, 105, 163, 227
 Conferva, 244
 Cooke, M. C., 90
 Conifers, 303
 Continentals, 159
 Copal, 114
 Copper, 58
 Creosote, 106
 Cross, M. I. 162, 223, 255, 330
 Crystals, 192
 Cultures, 22, 27, 35, 52
 Curtis, G. H. 263
 Cyperaceæ, 173
 Dallinger, W. H. 250
 Degeneration, 68
 Desmids, 84, 218
 Diatoms, 44, 85, 124, 263, 273, 276
 Dictionary, Gould's, 111
 Diffraction spectra, 324
 Diphtheria, 54
 Dobson, W. C. 1, 31
 Dowdy, S. E. 192
 Drugs, 16, 60, 97, 170, 261
 Dytiscus, 109
 Edwards, A. M. 61
 Eggs, 178
 Ehrlich's stain, 249
 Entomostraca, 15, 30, 105, 311
 Eosin, 248
 Ehippium of Bosmina, 311
 Epidermis, 110
 Epithemia, 265
 Ethmoid diaphragms, 287
 Euglena, 242, 303
 Evans, Sir John, 21
 Exhibits, 118, 148, 282
 Facets, 258
 Fishes, 196
 Flagella, 167
 Flemming, R. A. 67
 Fly-cage, 228
 Formaldehyde, 18, 270, 281
 Formalin, 286
 Fungi, 24, 57, 295
 Gage's Methods, 307
 Gaylord, H. R. 102
 Germ theory, 9
 Glycerine-jelly, 232

- Gnat, 253
 Gold-fish parasite, 230
 Gonorrhea, 217
 Gonococcus, 22, 55, 114, 214
 Haffkine, 40
 Halter of blow-fly, 299
 Haustoria, 173
 Heidenhain's fluid, 190
 Heliostat, 223
 Hermann's fluid, 189
 Herrera, A. L. 237
 Holland, W. J. 111
 Huxley, T. H. 156
 Hyalodiscus, 48, 322
 Hybridization, 44
 Hydrocyanic acid, 175
 Hydrozoa, 232
 Hydrachnidæ, 323
 Hypnotism, 120
 Illumination, 165
 Infection, 8
 Infusoria, 188
 Jackson, Jos. 101
 Jacques, W. K. 49
 Karyokinesis, 43
 Kelley, F. J. 273
 Kitasato, 34, 40
 Koch, 12
 Labels, 224
 Laveran, discoverer, 76
 Leeuwenhoek, A. 3
 Leitz, E. 170
 Lepidoptera, 236
 Magnetic healing, 120
 Malaria, 76
 Martensite, 16
 Massey, Geo. 295
 McFarland, Jos. I. 31
 Mead, S. G. 275
 Medusæ, 15
 Merlin, A. A. 121, 317
 Metals, 330
 Microbes, 223
 Micro-chemistry, 58, 81, 112, 150
 Micro-material, 236
 Microtomes, 57
 Midy, 212
 Mitchell, H. W. 72; W. C. 178
 Milk, 79, 85, 205
 Mites, 229
 Mollusca, 284
 Moore, V. A. 30
 Mosquitoes, 268
 Mould, 28
 Mounting, 172, 220, 232, 280
 Murder trial, 329
 Mushrooms, 144
 Myxobacteria, 144
 Myxomycetes, 146
 Navicula, 125, 322
 Nelson, E. M. 44, 129, 168
 Nematode galls, 144
 Nitzschia, 125, 321
 New publications, 30, 58, 89, 120, 150, 208,
 Nucleolus, 304
 Obert, H. D. 138
 Obituary, 86, 235, 283
 Objectives, 226
 Ordway, J. M. 287
 Picro-carmin, 234
 Pammel, L. H. 42, 144, 173, 262
 Pasteur, 12, 82
 Pathogenic bacteria, 31, 84, 262
 Pathogenic mould, 28
 Pepton, 37
 Peripheral neuritis, 67
 Pharmacy, see drugs
 Photo-micrography, 166, 175, 225, 257
 Plague, see bubonic
 Pleurosigma, 44
 Pollen, 115
 Pontederia, 289
 Pork, 179
 Postal society, 19, 230, 252, 299
 Prehistoric man's food, 199
 Preservation of objects, 15
 Protoplasm, 62, 237
 Prices, 106
 Quekett, 30 87, 149, 171, 208
 Rabies, 130
 Raphides, 285
 Red rain, 207
 Resolution, 87, 121, 317
 Rheinberg, J. 324
 Rotatoria, 195
 Rotifers, 230
 Rosenau, M. J. 75, 183, 268
 Royal Mic. S. 86, 104, 258, 306
 Rulings, 104
 Salmon, D. E. 130
 Sarcoma, 148
 Saunders, S. P. 99
 Scales, 107, 196
 Scales' notes 13, 104, 175, 195, 228, 258, 280, 303
 Scarlet fever, 54, 116,
 Schneider, A. 16, 99
 Sclerotina, 145
 Scourfield, D. J. 311
 Sea-weeds, 148, 209
 Serum, 41, 202
 Sewage, 262

- Slide-lending, 283
Small-pox, 116
Soar, C. D. 323
Societies, 86, 117, 307
Societies in England, 21, 180
Species of plants, 14
Spirogyra, 43
Sponges, 99
Sputum, 81, 113, 147, 204
Stains, 81, 83, 107, 114, 145, 167, 188, 233, 247
Starch, 44, 208, 332
Star-fish, 19
Steel, examined, 15
Sterlization, 79, 82, see cultures
Sulphur dioxid, 270
Surirella, 126, 323
Tannin, 81
Tape worms, 92
Terms, 332
Thermophore, 80
Trichina spiralis, 95
Tuberculosis, 53, 72, 74, 110, 204
Turpentine, 80
Typha, 290
Typhoid bacillus, 27, 178
Vaccine lymph, 23
Vaccination, 309
Walters, G. W. 223
Water exam. 58, 107, 241, 303
Water-mites, 323
Whelpley, J. D. 325
White, T. C. 199
Widal's reaction, 178

Vol. XXII, No.12

DECEMBER, 1901

No. 264.

THE AMERICAN MONTHLY Microscopical Journal.

ILLUSTRATED



Chas. W. Smiley, Publisher, May Building, Washington, D. C.

ASTHMA Cure Free!

Asthmalene Brings Instant Relief and Permanent Cure in All Cases.

SENT ABSOLUTELY FREE ON RECEIPT OF POSTAL
WRITE YOUR NAME AND ADDRESS PLAINLY.



There is nothing like Asthmalene. It brings instant relief, even in the worst cases. It cures when all else fails.

The Rev C. F. Wells, of Villa Ridge, Ill., says: "Your trial bottle Asthmalene received in good condition. I cannot tell you how thankful I feel for the good derived from it. I was a slave, chained with putrid sore throat and Asthma for ten years. I despaired of ever being cured. I saw your advertisement for the cure of the dreadful and tormenting disease, Asthma, and thought you had over-spoken yourselves, but resolved to give it a trial. To my astonishment, the trial acted like a charm. Send me a full-size bottle."

Rev. Dr. Morris Wechsler,
Rabbi of the Cong. Bnai Israel,
New York, Jan. 3, 1911.

DRS. TAFT BROS' MEDICINE CO.,
Gentlemen; Your Asthmalene is an excellent remedy for Asthma and Hay Fever, and its composition alleviates all troubles which

combine with Asthma. Its success is astonishing and wonderful.

After having it carefully analyzed, we can state that Asthmalene contains no opium, morphine, chloroform or ether.

Very truly yours, REV. DR. MORRIS WECHSLER.

DR. TAFT BROS. MEDICINE CO.

Feb. 5, 1911.

Gentlemen: I was troubled with Asthma for 22 years. I have tried numerous remedies, but they have all failed. I ran across your advertisement and started with a trial bottle. I found relief at once. I have since purchased your full-size bottle, and I am ever grateful. I have a family of four children, and for six years was unable to work. I am now in the best of health and am doing business every day. This testimony you can make such use of as you see fit.

Home address, 235 Rivington st.

S. RAPHAEL.

67 East 129th st., New York City.

AVON SPRINGS, N. Y., Feb. 1, 1901.

DR. TAFT BROS. MEDICINE CO.

Gentlemen: I write this testimonial from a sense of duty. Having tested the wonderful effect of your Asthmalene for the cure of Asthma. My wife has been afflicted with spasmodic asthma for the past 12 years. Having exhausted my own skill as well as many others. I chanced to see the sign upon your windows on 13th st, New York. I at once obtained a bottle of Asthmalene. My wife commenced taking it about the first of November. I very soon noticed a radical improvement. After using one bottle her Asthma has disappeared and she is entirely free from all symptoms. I feel that I can consistently recommend the medicine to all who are afflicted with this distressing disease.

Yours Respectfully,

O. D. PHELPS, M. D.

TRIAL BOTTLE SENT ABSOLUTELY FREE ON RECEIPT OF POSTAL

Do not delay. Write at once, addressing DR. TAFT BROS. MEDICINE CO., 79 East 130th St., N. Y. City.

Sold by all Druggists.

